Installation, Setup and Operation

INSTRUCTIONS

for

CE

SUNNEN® AUTOMATIC VERTICAL HONING MACHINE

(FOR AUTOMOTIVE & INDUSTRIAL APPLICATIONS)

Model CV-616

READ THE FOLLOWING INSTRUCTIONS THOROUGHLY AND CAREFULLY BEFORE UNPACKING, INSPECTING, OR INSTALLING THE SUNNEN® AUTOMATIC VERTICAL HONING MACHINE.

"SUNNEN AND THE SUNNEN LOGO ARE REGISTERED TRADEMARKS OF SUNNEN PRODUCTS COMPANY."

SUNNEN® PRODUCTS COMPANY • 7910 MANCHESTER AVENUE • ST. LOUIS, MO 63143, U.S.A. • PHONE: 314-781-2100

GENERAL INFORMATION

The Sunnen® equipment has been designed and engineered for a wide variety of parts within the capacity and limitation of the equipment. With proper care and maintenance this equipment will give years of service.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY AND THOROUGHLY BEFORE UNPACKING, INSPECTING, OR INSTALLING THIS EQUIPMENT.

IMPORTANT: Read any supplemental instructions BEFORE installing this equipment. These supplemental instructions give you important information to assist you with the planning and installation of your Sunnen equipment.

Sunnen Technical Service Department is available to provide telephone assistance for installation, programming, & troubleshooting of your Sunnen equipment. All support is available during normal business hours, 8:00 AM to 4:30 PM Central Time.

Review all literature provided with your Sunnen equipment. This literature provides valuable information for proper installation, operation, and maintenance of your equipment. Troubleshooting information can also be found within the Instructions. If you cannot find what you need, call for technical support.

Where applicable, programming information for your Sunnen equipment is also included. Most answers can be found in the literature packaged with your equipment.

Help us help you. When ordering parts, requesting information, or technical assistance about your equipment, please have the following information available:

- Have ALL MANUALS on hand. The Customer Services Representative or Technician will refer to it.
- Have Model Number and Serial Number printed on your equipment Specification Nameplate.
- Where Applicable: Have Drive model and all nameplate data. Motor type, brand, and all nameplate data.

For Troubleshooting, additional information may be required:

- Power distribution information (type - delta, wye, power factor correction; other major switching devices used, voltage fluctuations)
- Installation Wiring (separation of power & control wire; wire type/class used, distance between drive and motor, grounding).
- Use of any optional devices/equipment between the Drive & motor (output chokes, etc.).

For fast service on your orders call:

Sunnen Automotive Customer Service toll free at: 1-800-772-2878

Sunnen Industrial Customer Service toll free at: 1-800-325-3670

Customers outside the USA, contact your local authorized Sunnen Distributor.

Additional information available at: http://www.sunnen.com or e-mail: sunnen@sunnen.com

NOTE: Sunnen reserves the right to change or revise specifications and product design in connection with any feature of our products contained herein. Such changes do not entitle the buyer to corresponding changes, improvements, additions, or replacements for equipment, supplies or accessories previously sold. Information contained herein is considered to be accurate based on available information at the time of printing. Should any discrepancy of information arise, Sunnen recommends that user verify the discrepancy with Sunnen before proceeding.

ESD PREVENTION REVIEW

Let's review the basics of a sound static control system and its effective implementation. First, in the three step plan:

1. Always ground yourself when handling sensitive components or assemblies.
2. Always use a conductive or shielded container during storage or transportation. These materials create a Faraday cage which will isolate the contents from static charges.
3. Open ESD safe containers only at a static safe work station.

At the static safe work station, follow these procedures before beginning any work:

A. Put on your wrist strap or foot grounding devices.

B. Check all grounding cords to make sure they are properly connected to ground, ensuring the effective dissipation of static charges.

C. Make sure that your work surface is clean and clear of unnecessary materials, particularly common plastics.

D. Anti-static bubble wrap has been included for use at the machine when an ESD safe workstation is not available.

You are now properly grounded and ready to begin work. Following these few simple rules and using a little common sense will go a long way toward helping you and your company in the battle against the hazards of static electricity. When you are working with ESD sensitive devices, make sure you:

GROUND

ISOLATE

NEUTRALIZE

SUNNEN® LIMITED PRODUCT WARRANTY

Sunnen® Products Company and its subsidiaries (SPC) warrant that all new SPC honing machines, gaging equipment, tooling, and related equipment will be free of defects in material and/or workmanship for a period of one year from the date of original shipment from SPC.

Upon prompt notification of a defect during the one-year period, SPC will repair, replace, or refund the purchase price, with respect to parts that prove to be defective (as defined above). Any equipment or tooling which is found to be defective from improper use will be returned at the customer's cost or repaired (if possible) at customer's request. Customer shall be charged current rates for all such repair.

Prior to returning any SPC product, an authorization (RMA#) and shipping instructions must be obtained from the Customer Service Department or items sent to SPC will be returned to the customer.

Warranty Limitations and Exclusions This Warranty does not apply to the following:

- Normal maintenance items subject to wear and tear: (belts, fuses, filters, etc).
- Damages resulting from but not limited to:
  - › Shipment to the customer (for items delivered to customer or customer's agent F.O.B., Shipping Point)
  - › Incorrect installation including improper lifting, dropping and/or placement
  - › Incorrect electric power (beyond +/- 10% of rated voltage) including intermittent or random voltage spikes or drops
  - › Incorrect air supply volume and/or pressure and/or contaminated air supply
  - › Electromagnetic or radio frequency interference from surrounding equipment (EMI, RFI)
  - › Storm, lightning, flood or fire damage
  - › Failure to perform regular maintenance as outlined in SPC manuals
  - › Improper machine setup or operation causing a crash to occur
  - › Misapplication of the equipment
  - › Use of non-SPC machines, tooling, abrasive, fixturing, coolant, repair parts, or filtration
  - › Incorrect software installation and/or misuse
  - › Non-authorized customer installed electronics and/or software
  - › Customer modifications to SPC software

THE LIMITED WARRANTY DESCRIBED HEREIN IS EXPRESSLY IN LIEU OF ALL ANY OTHER WARRANTIES. SPC MAKES NO REPRESENTATION OR WARRANTY OF ANY OTHER KIND, EXPRESS OR IMPLIED, WHETHER AS TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER MATTER. SPC IS NOT RESPONSIBLE FOR THE IMPROPER USE OF ANY OF ITS PRODUCTS. SPC SHALL NOT BE LIABLE FOR DIRECT, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES INCLUDING BUT NOT LIMITED TO: LOSS OF USE, REVENUE, OR PROFIT. SPC ASSUMES NO LIABILITY FOR PURCHASED ITEMS PRODUCED BY OTHER MANUFACTURERS WHO EXTEND SEPARATE WARRANTIES. REGARDLESS OF ANY RIGHTS AFFORDED BY LAW TO BUYER, SPC's LIABILITY, IF ANY, FOR ANY AND ALL CLAIMS FOR LOSS OR DAMAGES WITH RESPECT TO THE PRODUCTS, AND BUYER'S SOLE AND EXCLUSIVE REMEDY THEREFORE, SHALL IN ALL EVENTS BE LIMITED IN AMOUNT TO THE PURCHASE PRICE OF THAT PORTION OF THE PRODUCTS WITH RESPECT TO WHICH A VALID CLAIM IS MADE.

Shipping Damages

Except in the case of F.O.B., Buyer's destination shipments, SPC will not be liable for any settlement claims for obvious and/or concealed shipping damages. The customer bears the responsibility to unpack all shipments immediately and inspect for damage. When obvious and/or concealed damage is found, the customer must immediately notify the carrier's agent to make an inspection and file a claim. The customer should retain the shipping container and packing material.

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Any alteration or reverse engineering of the software is expressly forbidden and is in violation of this agreement.

SPC reserves the right to update the software covered by this agreement at any time without prior notice and any such updates are covered by this agreement.

SAFETY INSTRUCTIONS

READ FIRST

This machine, like any equipment, may be dangerous if used improperly. Please read all warnings and instructions before attempting to use this machine.

Always disconnect power at main enclosure before servicing machine.[1]

Always wear eye protection when operating this machine.

NEVER open or remove any machine cover or protective guard with power "ON." Always disconnect power at main enclosure before servicing this equipment.[1]

DO NOT attempt any repair or maintenance procedure beyond those described in this book. Contact your Sunnen® Field Service Engineer or Technical Services Representative for repairs not covered in these instructions.

Due to the wide variety of machine configurations, all possibilities cannot be described in these instructions. Instructions for safe use and maintenance of optional equipment ordered through Sunnen, will be provided through separate documentation and/or training provided by your Sunnen Field Service Engineer or Technical Services Representative.

DO NOT attempt to defeat any safety device on this machine or on any of the optional equipment.

If specially built automation components are added to this system, be sure that safety is not compromised. If necessary, obtain special enlarged work area safety system from Sunnen Products Co.

CE Indicates CE version ONLY.

[1] DO NOT touch electrical components until main input power has been turned off and *CHARGE* lamps are extinguished. WARNING: The capacitors are still charged and can be quite dangerous.

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GENERAL INFORMATION & SPECIFICATIONS

Sunnen® Automatic Vertical Honing Machine - Model CV-616

Diameter (ID) Range[1]:	19 to 203 mm (.75 to 8.00 in.) For diameters below 19mm (.75 in.) or above 203 mm (8.00 in.), call Sunnen in St. Louis
Length Range:	Up to 450 mm (Up to 18 in.), depending on diameter
	Automotive Applications
Capacity:	V-Blocks, both 60º and 90º; overhead and L-head in-line locks; angle head blocks; up to 1067 mm (42 in.) long
Cylinder –	
Diameter:	76 to 127 mm (3 to 5 in.) with standard hone head. Full range from 51 to 203 mm (2 to 8 in.)
Length:	Up to 279 mm (11 in.); 457 mm (18 in.) with special tooling
Floor Area:	2267 W x 1835 D x 2197 mm (89.25 x 72.25 x 86.50 in.)
Spindle Speed:	125, 170, 230, 310 rpm
Speed Drive:	1,5 kw (2 hp) 1750 rpm
Stroke Rate:	41, 57, 80 spm
Stroke Length:	0 to 229 mm (0 to 9 in.)
Floor Weight –	
Dry:	860 kg (1900 lbs)
w/Coolant:	1050 kg (2300 lbs)
Shipping Weight:	1150 kg (2500 lbs)
Coolant Pump:	0,75 kw, 37 LPM (1 hp / 10 GPM) Positive Displacement Pump
Filter System:	Self-contained replaceable 5 micron twin filter cartridges
Coolant Capacity:	208 liters (55 gal.)
Electrical Requirements:	208/230/460 V, 3 Ph, 60 Hz 220/380/440 V, 3 Ph, 50 Hz
Pneumatic Requirements:	566 L/min (20 CFM) 5,5-6,9 BAR (80-100 psi)
Color:	Pearl Gray, Pewter Gray & Burgundy Trim

[1] Diameter range, length range, and workpiece weight are contingent on workpiece and application.

INTRODUCTION

This Instruction Manual provides information required to install, operate, and maintain the Sunnen® Automotive Vertical Honing Machine.

When ordering parts for, or requesting information about your unit, include the serial and model numbers of your machine.

Read the following instructions carefully and thoroughly before unpacking, inspecting, installing or operating your machine.

The Sunnen CV-616 Vertical Honing Machine continues to set the standards for both industrial and automotive applications for precision and speed for bore sizing and finishing in large workpiece and engine block applications.

INDUSTRIAL: This one machine can handle a wide variety of bore sizing and finishing operations, especially in big, heavy and odd-shaped workpieces that typically present fixturing problems in most horizontal machines.

AUTOMOTIVE: One machine does the total job of re-sizing and finish-honing all the cylinders in any type block.

In this manual the symbol CE indicates steps or information that are only for the CE version of this machine.The CE version is constructed to meet the highest level of safety standards as required by the european Machinery Directive. Required for the European market, this CE version is available for any customer. The regular version of this machine is quite safe for any operator exercising a normal degree of caution associated with machine tool use. The CE version provides an extra level of protection by minimizing the risks of operator carelessness.

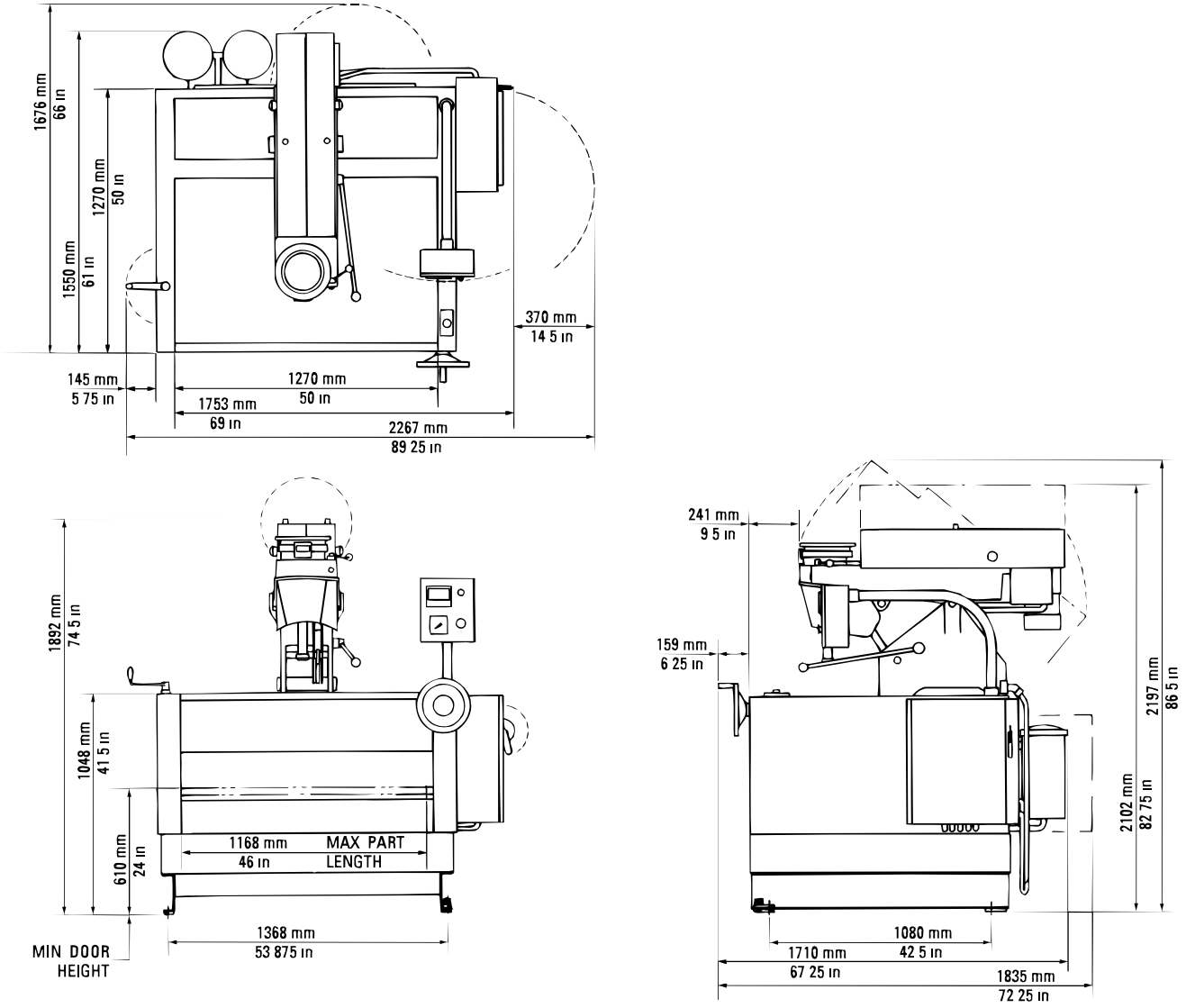

FIGURE 1-A, Machine Layout

SECTION 1
INSTALLATION

PURPOSE

Consult this section when unpacking, inspecting and installing Sunnen® CV-616 Automatic Vertical Honing Machine (see Figure 1-A). Hereafter referred to as the Machine.

SUGGESTED TOOLS & MATERIALS

The following tools and materials are required for unpacking and installing your machine.

Knife	Hammer
Crow Bar	Tin Snips
Slip Joint Pliers	Cleaning Solvent
Screwdriver (Std)	Hex Wrenches
Open End Wrenches	

UNPACKING & INSTALLATION

Read the following instructions carefully and thoroughly before unpacking, inspecting, installing or operating your machine.

All references to right and left in these instructions, unless otherwise noted, are as seen by the operator as one looks at the machine or assembly being described (see Figure 1-1).

NOTE: When ordering parts for, or requesting information about your Machine, include the Model and Serial Numbers printed on the Nameplate of your Machine. The Nameplate is located on the Electrical Control Enclosure.

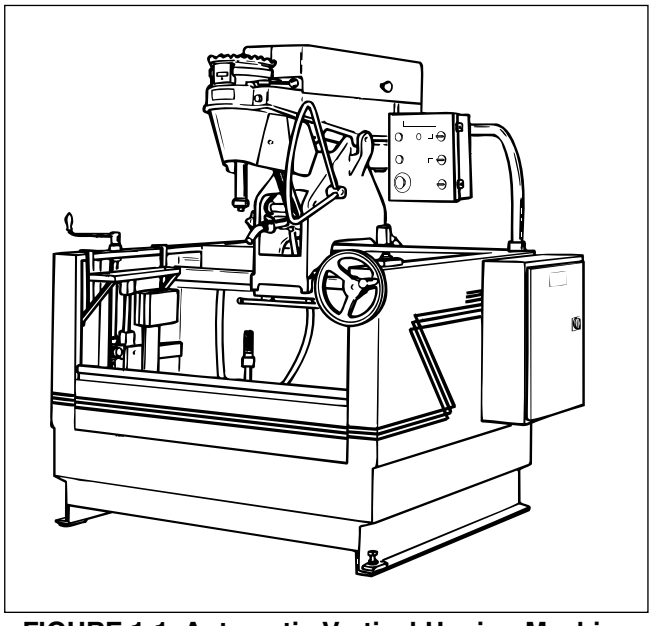

FIGURE 1-1, Automatic Vertical Honing Machine

1. Unpack machine and packaged components carefully and check contents against packing list before discarding any packing material.

2. With packing material removed from under carriage and carriage roller in contact with top rail, set Shoe to have .010 in. (0,25 mm)clearance with bottom of rail (see Figure 1-2).

3. Level machine accurately in desired location using shims and Leveling Screw at front corner of base.

4. Lift left side of belt cover and check that all belts remain properly seated in their respective grooves after shipment.

CE OVERARM SAFETY GUARD

Install Overarm Safety Guard as follows:

1. Unpack Overarm Safety Guard and hardware, and check contents against packing list before discarding any packaging materials.

2. Use hoist to lift guard into position and align hole in guard brackets with threaded holes in machine carriage (refer to Figure 1-2).

3. Secure guard to machine using bolts and lockwashers provided. Tighten bolts.

4. Attach left and right Guard Extensions to Guards using bolts provided. Tighten bolts.

5. Attach left and right Guards to Carriage using bolts and washers provided. Tighten bolts.

NOTE: Use washers (provided) as spacers between Carriage Extensions and Carriage.

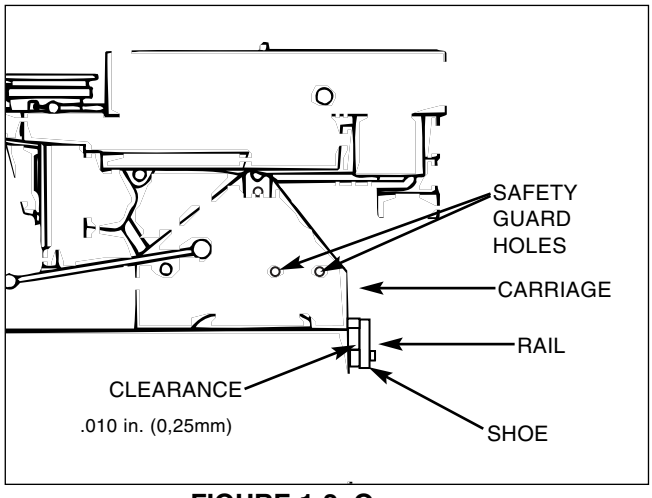

FIGURE 1-2, Overarm

ELECTRICAL CONNECTIONS

All wiring is to be performed by a competent, Licensed Electrician in accordance with all local, state, and federal codes and regulations.

Connect Electrical Control Enclosure (see Figure 1-3) to three-phase power source of voltage and frequency indicated on control panel door.

WARNING

Electrical Equipment, service should be performed by authorized personnel ONLY.

1. Unlock Door to Electrical Control Enclosure.

CAUTION

Door is equipped with lockable Safety Door Latch. Door should be closed and latched during operation to prevent accidental interruption of operation from doors being opened. Door Latch should be Locked-Out and Tagged during servicing to prevent machine from being powered up.

WARNING

You must use the hole provided. Drilling any new holes in the electrical enclosure may void the warranty.

2. Remove hole plug located on top, right side of the enclosure. Then install an oil tight fitting.

NOTE: Entire machine is wired to operate on voltage and frequency indicated on specification plate. All motors are protected from overload for indicated voltage only. If machine is to be operated on voltage other than that indicated, all overload protectors must be changed, motor wiring changed, and control transformer connection changed.

3. Install an Oil Tight Fitting (not supplied).

4. Insert Electrical Supply Cord through hole and route to Electrical Disconnect Block.

5. Strip 254 mm (10 inches) off cable's outer jacket.

6. Strip 6 mm (1/4 inch) of insulation off each wire.

7. Connect Green Wire (GRN) to grounding stud as noted in illustration.

8. Connect remaining three (3) wires to Block as noted on Block.

9. Close Door to Enclosure.

10. Route and connect Electrical Supply Cord to factory main power source.

WARNING

CE Check all guards and insure they are in place and locked before operating machine.

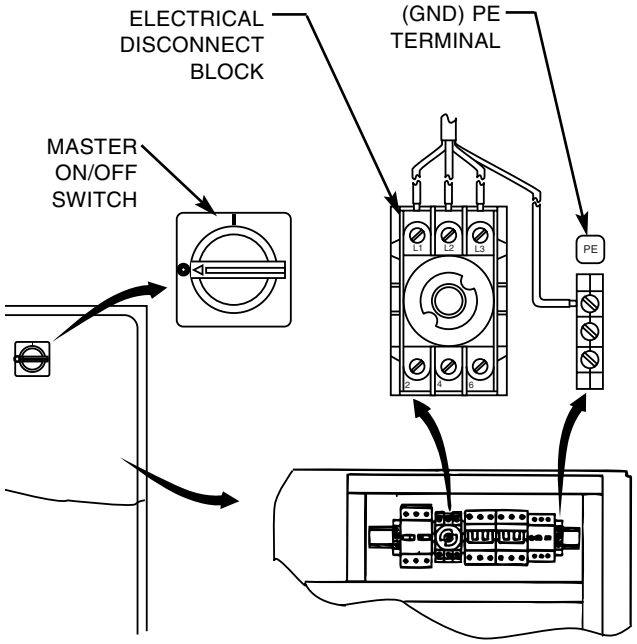

FIGURE 1-3, Electrical Enclosure

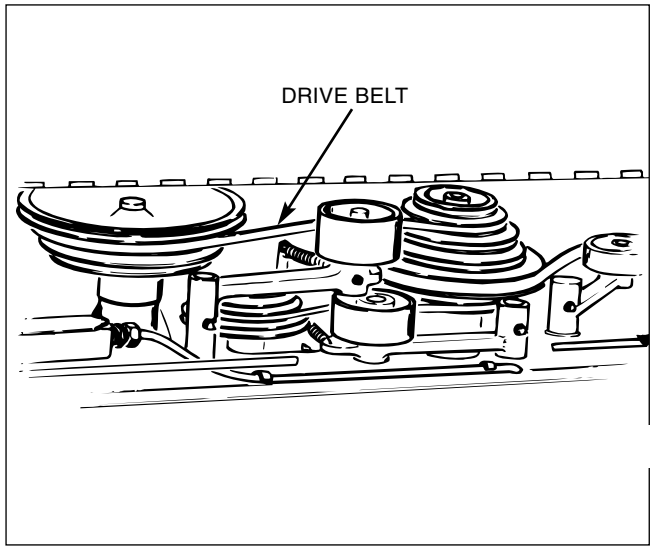

FIGURE 1-4, Main Drive Belt

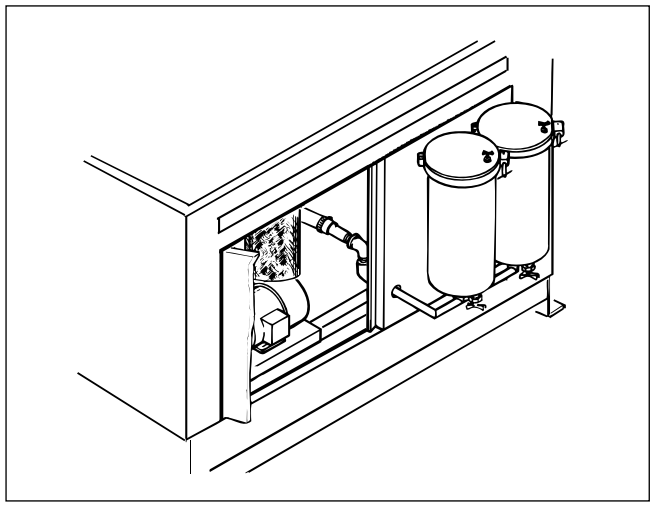

FIGURE 1-5, Filter Canisters

OPERATIONAL CHECK

Remove main drive belt and make sure Lift Lever is down (see Figure 1-4). Push Clutch Control Lever to start motors and check that air is being blown from vent on side of machine. If air is not being blown from vent, shut off machine (Emergency Stop Button), shut off main disconnect switch and reverse any two main power leads. Do not reverse individual motor leads.

DO NOT re-install main drive belt at this time.

FLUIDS

This machine is shipped without filter elements installed in Filter Canisters. Install filter elements as follows (see Figure 1-5):

WARNING

Make sure main drive belt is removed.

CE Check all guards and insure they are in place and locked before operating machine.

---

1. Open Door on rear of Machine.

2. Remove Cover Clamps and Covers.

3. Remove filter elements from protective bag and insert elements into Filter Canisters, rotating elements slightly while inserting to make them slide down center post more easily.

4. Replace Covers, centering carefully on rubber gaskets to assure no leakage.

5. Replace Clamps and tighten. Tighten Hex Bolt in Clamp Halves until halves meet, then tighten T-Handle.

6. Partially open Air Vents in Covers. 7. Fill machine base reservoir with 190 to 210 liters (50 to 55 gallons) of Sunnen Honing Oil. Dump oil into front of machine and let it overflow into reservoir.

8. Turn main disconnect switch to ON.

9. Raise front sliding door and direct oil spout downward.

10. Push Power ON Button and start motor by pushing Clutch Control Lever all the way back.

11. As oil fills filter canisters, air will escape through air vents. When oil appears in air vents, close vents.

NOTE: Honing oil should flow from oil spout. Control amount of oil by regulating.

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12. Turn OFF power.

13. Wipe oil from around air vents.

14. Replace main drive belt.

15. Close doors.

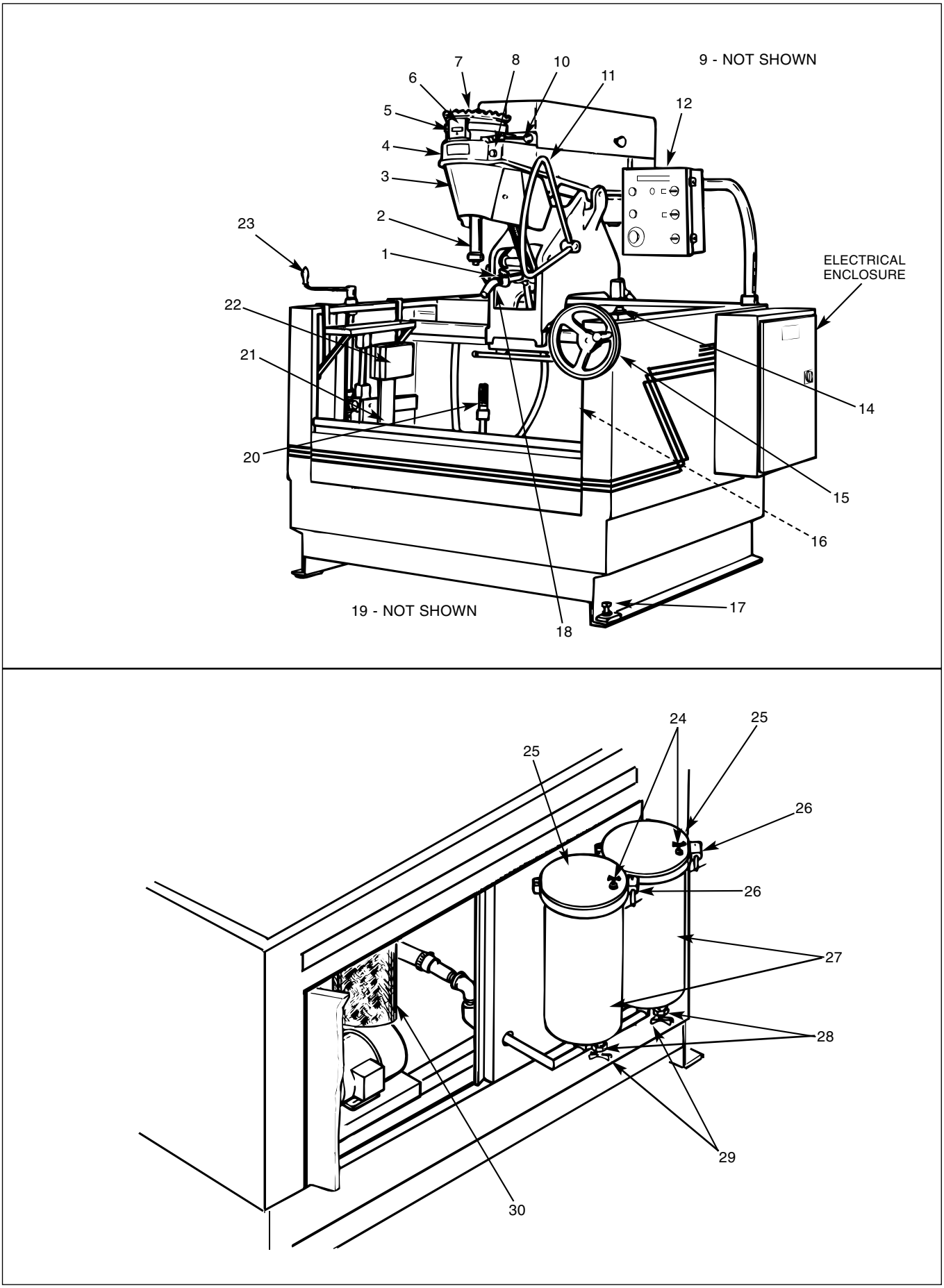


FIGURE 2-1, Major Components

SECTION 2
PREPARING FOR OPERATION

GENERAL

Consult this section when preparing the Machine for operation.

MAJOR COMPONENTS

For the location of the major components on your machine see Figure 2-1.

1. “Oil” SHUT OFF VALVE Regulates flow of honing oil.

2. DRIVE TUBE (Upper Half) Transmits the rotation and stroking motion from the Drive Arm to the Hone Head.

3. DRIVE TUBE GUARD

4. DRIVE ARM ASSEMBLY Produces the stroking and rotational motion.

5. GRADUATED FEED DIAL ASSEMBLY Indicates amount of stone feed, and controls when the honing cycle will stop.

6. INDEX PLATE ASSEMBLY Calibrates each graduation on Feed Dial according to tooling being used.

7. HAND WHEEL ASSEMBLY Feeds out or retracts stones in Hone Head.

8. “Motor On” INDICATOR LIGHT (Green) Indicate that all motors are on.

9. SETUP CHART* (Not Shown)

10. CLUTCH CONTROL LEVER ASSEMBLY Push back to start motors; pull forward to engage drive.

11. LIFT LEVER ASSEMBLY Lowers the Hone Head into the bore (cylinder) to be honed.

12. OPERATOR CONTROL PANEL Houses controls for checking and producing straight bore (cylinder).

13. MAIN ELECTRICAL CONTROL ENCLOSURE Contains electrical controls and main switch.

14. DWELL CONTROL BUTTON Provides a single dwell cycle when button is depressed; provides continuous dwell for blind holes when outer ring is rotated.

15. “Traverse” HAND WHEEL ASSEMBLY Moves the Carriage and Drive Arm sideways, from bore to bore (cylinder to cylinder).

16. POSITIONING LATCH (Hidden) Used to hold Cradle in correct angular position.

17. LEVELING SCREW Used to level machine.

18. “Oil” NOZZLE Directs flow of honing oil.

19. RISER BLOCKS* (Not Shown) Adapt different sizes and styles of workpieces (style engine blocks) to the Cradle.

20. CLAMPS NUTS* Used to hold workpiece (engine block) to Cradle.

21. CRADLE ASSEMBLY Provides the mounting for the workpiece (engine block).

22. CRADLE COUNTERWEIGHT KIT** Balances offset cradle when honing small parts.

23. ELEVATING CRANK Vertically positions the workpiece (engine block) on the Cradle.

24. AIR VENTS

25. COVERS

26. COVER CLAMPS

27. FILTER CANISTERS

28. STANDPIPES

29. DRAIN COCKS

30. FILTER ELEMENT STORAGE AREA

* Supplied with CK-1200 Clamp Kit (ordered separately).

** Should be removed when honing V-type engine blocks.

OPERATOR CONTROLS

For the function and location of the operator controls, refer to Table 2-1 and Figure 2-2 on page 6.

MACHINE CONTROLS

For a description of other Controls and Warning Symbols used on this machine, refer to Table 2-2 on page 7.

SAFETY PRECAUTIONS

The following precautions should be followed to ensure maximum safety. These precautions are presented as basic guidelines. Like any machinery or tooling, this unit may be dangerous if used improperly. Be sure to read the following precautions and all the instructions covered in this manual before operating this unit. Always use common sense when operating this or any machine/tool.

Special precautions should be observed regarding: GUARDING, START-UP, OPERATING, SERVICING and ELECTRICAL Applications.

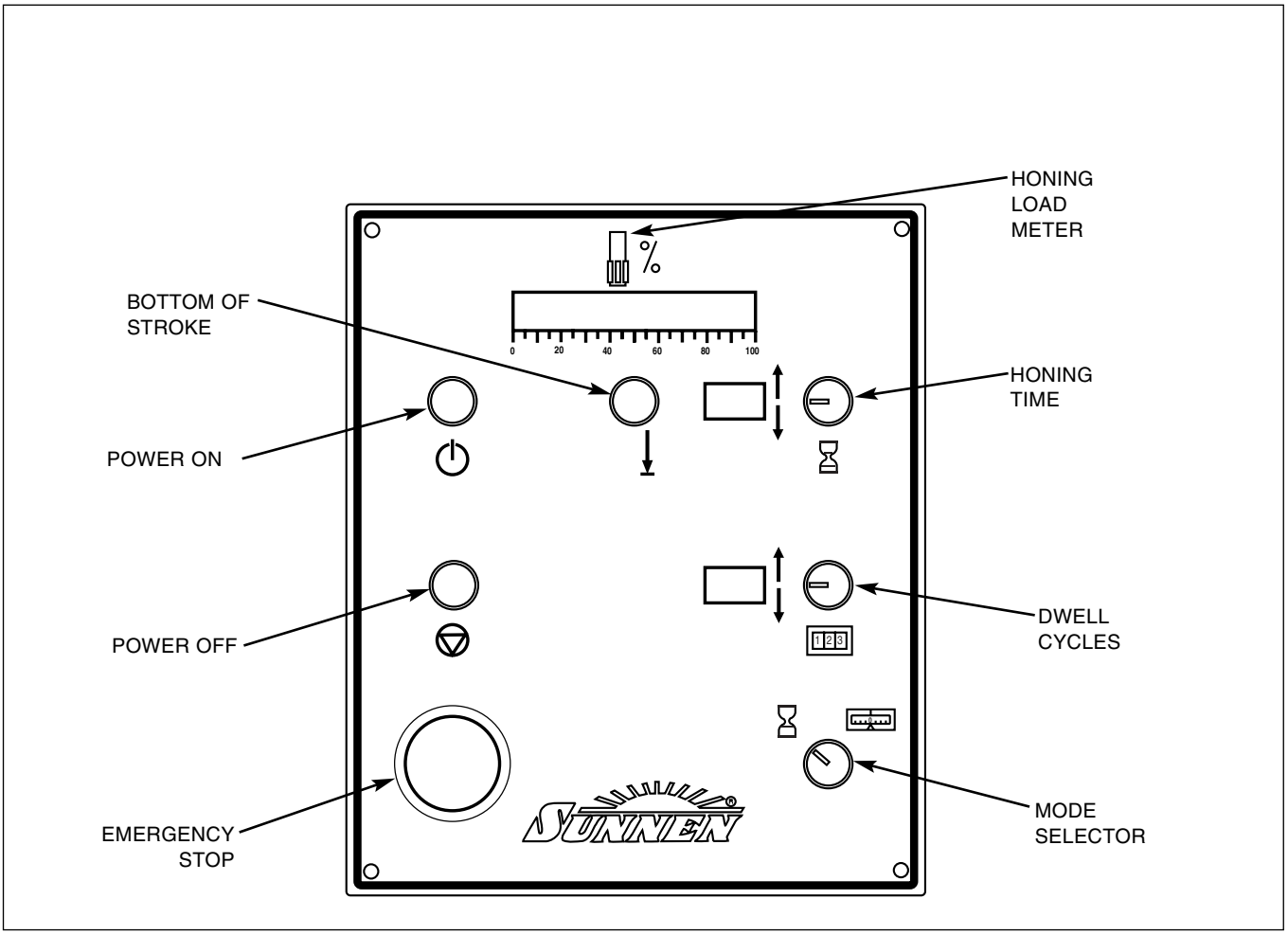
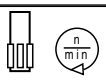
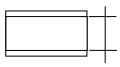
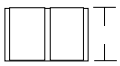
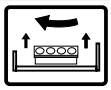
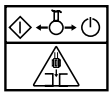


FIGURE 2-2, Operator Controls

TABLE 2-1, Operator Controls

SYMBOL	DESCRIPTION	FUNCTION
(HONING LOAD METER)	LED	Indicates stone cutting action and cylinder straightness.
(HONING TIME)	Dial	Switch is used to set honing time in seconds, as displayed in the indicator window.
(BOTTOM OF STROKE)	Yellow Indicator Light	Indicates when Hone Head is at the bottom of the stroke.
(POWER ON)	White Pushbutton Switch	Turns ON electrical power to Machine's Operator Controls; places machine in standby mode.
(POWER OFF)	Red Pushbutton Switch	Turns OFF electrical power to Machine's Operator Controls; and turns off power to motors, but does not shut off power to the machine.
(DWELL CYCLES)	3 Position Selector Switch	Switch is used to set the number of strokes the machine will dwell at the bottom of stroke, as displayed in the indicator window.
(MODE SELECTOR)	2 Position Selector Switch	TIMED – Machine will hone until the number of seconds on the Honing Time display reaches zero. Zero SHUTOFF – Machine will hone until zero is reached on the Graduated Feed Dial (5).
(EMERGENCY STOP)	Red Locking Pushbutton Switch	Turns OFF power, Stopping the Machine. MUST be released before Power ON Button can be depressed.

TABLE 2-2, Other Machine Controls & Warning Symbols

SYMBOL	DESCRIPTION	FUNCTION
	Warning Label	Warns that an electrical hazard exists.
	Dwell - Single	With dwell switch turned to this symbol depressing button will result in a single dwell cycle.
	Dwell - Continuous	With dwell switch turned to this symbol depressing button will result in a continuous dwell cycle set by the dwell timer on the control panel.
	Spindle Speed	
	Bore Diameter	
	Strokes Per Minute	
	Stroke Length	
	Automotive Cylinder Length	
	Cradle Height Adjustment	Indicates direction to turn elevating crank to raise cradle.
	Clutch Control	Indicates that when clutch lever is pushed back to ⏻ position motors are ON and the machine is in stand-by condition. When clutch lever is pulled to ⏀ position honing cycle begins. Warns that the clutch lever should not be pulled forward until honing tool is properly positioned within workpiece.
	Motor ON Light	When light is on, indicates that the machines motors are ON.
	Warning Light	Warns that power must be OFF with belt guard open to prevent injury.
	Warning Label	Warns that safety glasses should be worn at all times when operating this machine.

Regulations

Adhere to all local, state and national codes and regulations when working on and around your machine/tool.

Machinery

Know your machine and/or power tool. Read the instructions packaged with your machine/tool carefully and thoroughly. Learn the machine's/tool's proper application and limitations, as well as the specific potential risk of injury peculiar to it.

Ensure all guards are in place and in working order before operating.

Keep children and visitors away. Ensure area is clear of other personnel before operating machine.

Keep loose tools and other foreign objects clear of machine.

Eliminate doubt – lock it out. Make workshop (machine / tool) visitor and child proof by installing lockouts, padlocks, master switches or by removing starter keys.

Never leave machine/tool running unattended. Turn off power, and if need be lock out.

Eliminate doubt - lock it out and tag. The tag should say "Do Not Start" or other similar words and include name of worker who tagged it. List the date,

time work begun, and type of repair work being performed. Protect your lock and key. Never let someone else remove your lock for you.

Be aware of all energy sources. Disconnect or turn off all power sources (electrical, pneumatic, hydraulic, etc.) from the machine/tool before servicing, and when changing accessories which do not require power.

Avoid accidental starting. Make sure switch is in off position or E-Stop button is depressed before plugging in the machine/tool.

Safety Equipment

Wear proper safety items, such as safety glasses, gloves, non-slip safety shoes and other personal safety equipment as necessary or required. Wear protective hair covering to contain long hair.

Select proper eye protection for the job. Check eyewear daily – clean dirty lenses and frames and replace broken or cracked lenses. Don't wear someone else's eye equipment.

Keep work area well lighted. Ensure you have enough light to work efficiently.

Wear proper apparel. DO NOT wear loose fitting clothes, neckties, rings, bracelets or other jewelry which can become caught in moving parts.

Work Area

Keep work area clean. Keep area around machine free
of paper, oil, water and all other debris at all times. Clean up spills and debris immediately. Cluttered areas and benches invite accidents.

Clean up lubricant spills immediately.

Secure workpiece. Use clamps or workholding fixture to hold workpiece. Do not try to hold workpiece in your hands.

Keep hands clear of moving parts while the machine/tool is in operation.

Remove adjusting keys and wrenches. Form a habit of checking to see that keys and adjusting wrenches are removed from the machine/tool before turning it on.

Don't force tool. It will perform better and safer on the job for which it was designed, and at the rate for which it was designed.

Use recommended accessories. Consult your instructions for the recommended accessories to be used with your machine/tool. The use of improper accessories may damage your machine/tool or cause risk or injury to the operator or other personnel.

Use the right tool. Don't force tool or attachment to do a job for which it was not designed.

Maintain tools with care. Keep tools sharp and clean for best and safest performance. Follow instructions for maintenance, lubrication and changing accessories.

Never stand on the machine/tool. Serious injury could occur if the machine/tool should tip or the unit was turned on.

Check for damaged parts. Before operating the machine, tool, guard, or other part or accessory that was involved in an jam, wreck, etc.; it should be checked to assure that it will operate properly and perform its intended function. Do not use a part that has been damaged. A guard or other safety item that is damaged should be properly repaired or replaced.

Check direction of rotation. Ensure motors and tools are rotating in the proper direction before operating your machine/tool.

Ensure guards and safety switches are operating. Ensure guards and shields are in proper working order and in position before operating the machine/tool. Ensure safety switches are in proper working order; do not override safety switches.

Electrical

Ensure the machine/tool is properly grounded to protect the operator from electrical shock.

All electrical work should be done by a qualified electrician.

Turn OFF electrical power at Electrical Control Enclosure, Master ON/OFF Switch when performing service not requiring power.

Turn OFF electrical power at Main Power Source when performing maintenance on, or cleaning of Electrical Control Enclosure.

Never touch an electrical cord or equipment with wet hands.

Never overload a circuit with high-wattage equipment. Keep extension cords away from moisture, heat, and pipes.

Be sure all appliances and power tools carry an Underwriters Laboratory tag.

Avoid dangerous environment. Don't use power machine/tool in damp or wet locations, in explosive atmospheres, or expose them to rain. If machine/tool becomes damp or wet, dry out completely and have it checked by a qualified electrician and a mechanic or machinist.

Handling

Don't overreach. Keep proper footing and balance at all times.

When lifting workpiece or tooling, use proper lifting procedures.

Avoid carrying loads that block your vision.

Pay attention when you're walking or climbing. Avoid hurrying, stopping short, or changing direction too quickly.

Learn the technique of safe lifting.

If you move something on a handtruck, push – don't pull.

Squat – don't bend when you have to reach low.

Twist – don't turn your whole body in the direction you want to go.

For repetitive tasks, use the proper grasp. Isolate the hand from vibration.

Try to reduce the force needed to accomplish a task. Design tasks, equipment, and tools to keep the wrist in a natural (or neutral) position. Reduce the number of motions or smooth them.

Conserve

Recycle – Place all materials in the proper recycling bin.

Return shop coats and towels for cleaning.

Accidents

Report all close calls and accidents.

Plan the safe way out in case of fire. Develop a fire escape plan that includes a place to meet. Practice it regularly.

Install smoke detectors – test them monthly – change the batteries twice a year.

Place fire extinguishers around the workplace.

WARNING

Ensure all guards, shields and safety switches are in place and in proper working order before operating this machine. Further ensure that all other personnel are clear of the machine and that your hands are clear of any moving part before turning on and operating the machine. Wear proper safety equipment when operating the machine.

The following electrical procedures should be performed only by a qualified electrician. Dangerous voltage levels are present.

Read and adhere to the safety precautions included in these instructions and precautions included with any accessories or tooling, as well as any WARNING or CAUTION labels on the machine before operating
the machine.

Be sure to read any MSDS sheets regarding coolant, honing oils, stones, etc., used with, in or on your machine.

NOTES

SECTION 3
SETUP & OPERATION

GENERAL

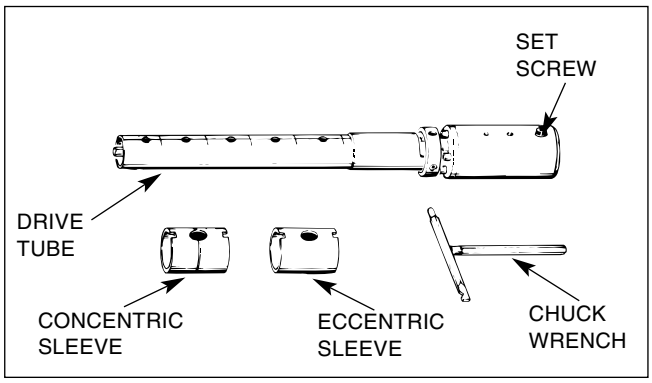
Stone Wear

To calculate stone wear ratio, divide stock removed by amount stone wore. You get the stock removed by gaging the last cylinder honed. To get the stone wear, subtract stock removed from number used in the last cylinder.

Example:

10-1/2 Base number (from last cylinder)
– 6 Stock removed (from last cylinder)
4-1/2 Difference (stone wear: 10-1/2 – 6 = 4-1/2)

$$\text{STONE WEAR RATIO} = \frac{\text{STONE WEAR}}{\text{STOCK REMOVED}} = \frac{4\text{-}1/2}{6} = .75 \text{ OR } 3/4$$



FIGUR E 3-1, CV Mandrel Adapter

TABLE 3-1, P28 Mandrels

P28 MANDREL	STONE USED	STONE LENGTH		MINIMUM OVERSTROKE		MAX. BORE* LENGTH POSSIBLE		MAX. BORE LENGTH FOR EASY LIFT-OUT	
		mm	in	mm	in	mm	in	mm	in
2-Stone	1	83	3.3	13	.5	220	8.8	220	8.8
2-Stone	2	167	6.6	25	1.0	210	8.3	210	8.3
3-Stone	2	167	6.6	25	1.0	290	11.6	290	11.6
3-Stone	3	250	9.8	25	1.0	290	11.6	290	11.6
4-Stone	3	250	9.8	25	1.0	380	14.9	380	14.9
4-Stone	4	330	13.1	25	1.0	380	14.9	360	14.2
5-Stone	4	330	13.1	25	1.0	460	18.1	360	14.2
5-Stone	5	420	16.4	25	1.0	460	18.1	280	11.0

* When using a 4 or 5-stone mandrel with 4 or 5 stones, it is possible to hone the lengths listed in the "Max. Bore Length Possible" column. However, it will not be possible to withdraw the mandrel from the workpiece without first lowering or removing the workpiece.

TABLE 3-2, CV-Series Hone Heads

HONE HEAD	DIAMETER RANGE		STONE LENGTH		MINIMUM OVERSTROKE		MAX. BORE LENGTH	
	mm	in	mm	in	mm	in	mm	in
CV-2400	51- 76	2.0-3.0	76	3.0	13	.5	330	13.0
CV-3000	76-102	3.0-4.0	89	3.5	15	.6	338	13.3
CV-3300	84-127	3.3-5.0	89	3.5	15	.6	338	13.3
CV-4000	102-203	4.0-8.0	152	6.0	25	1.0	381	15.0

Extra Fine Stones

Finishing stones, 280 grit and finer, are available for high performance, competition and test engines, as well as other requirements.

When using these extra fine stones, take care to avoid Glazing, which is caused by insufficient stone pressure or Stone Crumbling, which is caused by too high of a stone pressure.

NOTE: Stones must be fully radiused to cylinder diameter to assure consistent load meter readings and results.

Advance Feed Handwheel smoothly and at a moderate speed to the proper position on each cylinder. When this is done, the initial load meter reading will not vary more than 10% from the final reading on the normal reading of the load meter for that particular abrasive on that particular block.

HIGH LOAD METER READING

An initial load meter reading of more than 10% above reading for the previous cylinder indicates:
Feed Handwheel has been manually advanced too far.
Feed Handwheel has been manually advanced too fast.
In either case, the result is a higher than normal stone breakdown and a rougher than normal surface finish for that particular abrasive.

LOW LOAD METER READING

An initial load meter reading of more than 10% below the reading for the previous cylinder indicates the Feed Handwheel has not been manually advanced far enough, or it has been manually advanced too slowly. The surface finish left by the prior operation is too rough for the stones being used; therefore, an intermediate stone must be used between the rough and the fine finish honing operation. Stone glazing and smoother than normal surface finishes will result from incorrect Handwheel pressure. Erratic surface finishes and excessive finishing stone wear will result from incorrect Stone selection.

TOOLING

Refer to Sunnen Industrial or Automotive Honing Supplies Catalog for all your honing needs.

For bores with diameters smaller than 60 mm (2.4 in.) or bores over 280 mm(11 in.) long with diameters smaller than 66 mm (2.6 in.), use Sunnen CV-1000 Mandrel Adapter and P28 Mandrels (see Figure 3-1; and Tables 3-1 & 3-2).

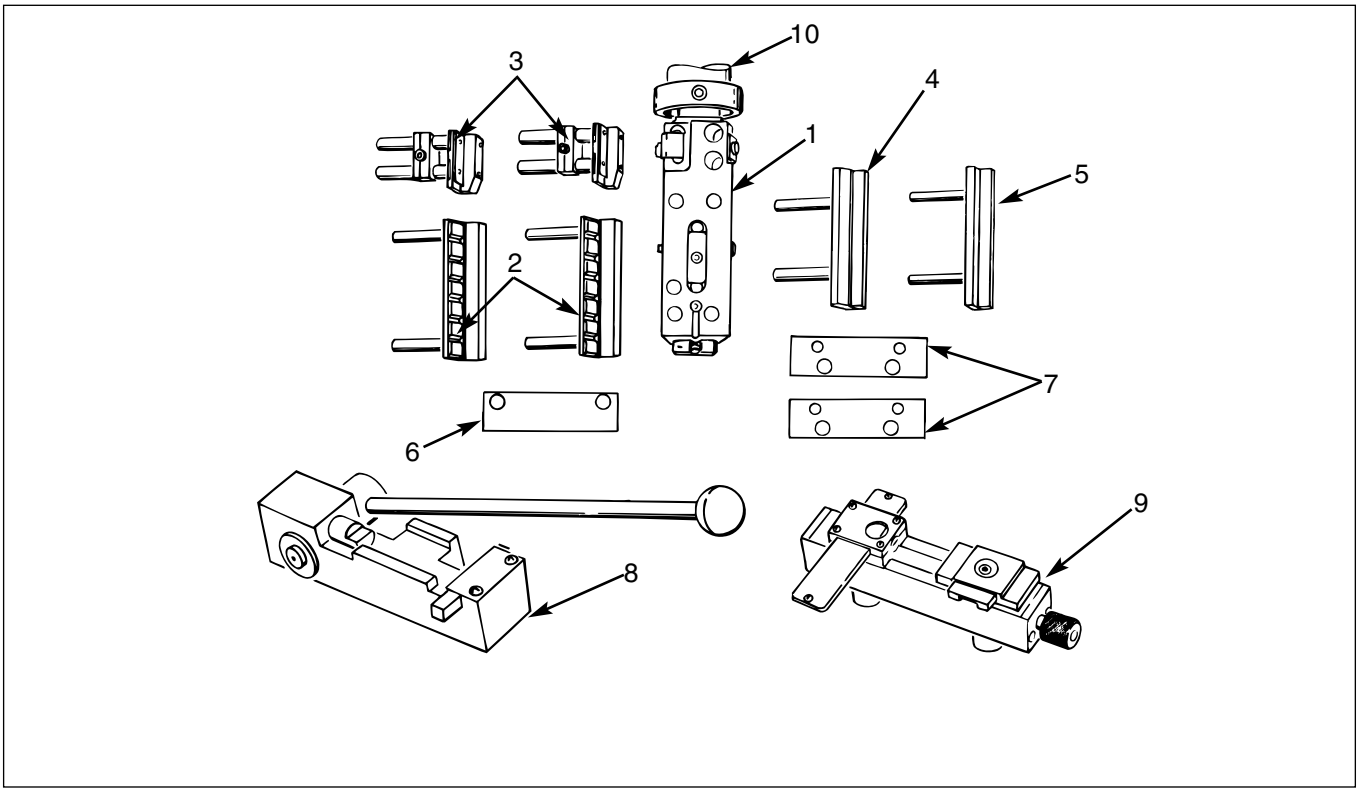


FIGURE 3-2, CV Hone Head

For bores with diameters from 60-152mm (2.4-6.0 in.), use Sunnen CV-Series Hone Head (see Figure 3-2 & Table 3-2).

1. HONE HEAD Supports stones and guides. Sides are stamped 1, 2, 3, and 4, and are thus referred to in these instructions.

2. STONE ASSEMBLIES (assembled with Master Holders) Used in Sides #1 and #2 and perform the cutting action.

3. ALIGNMENT GUIDES Assures correct wear pattern of Stones.

4. MAIN GUIDE (used in Side #3) Maintains centering and alignment of hone head in cylinder.

5. CENTERING GUIDE (used in Side #4) Used to assure proper centering of hone head.

6. STONE SHIMS Used to extend range of Stone Assemblies.

7. GUIDE SHIMS Used with Main and Centering Guides to center hone head in cylinder.

8. STONE INSERTER Used to insert stones in Master Holders.

9. SETTING GAGE Indicates thickness of Shims required to set Guides and Stones to cylinder diameter. Also used to adjust Alignment Guides.

10. DRIVE TUBE Connects Hone Head to Machine.

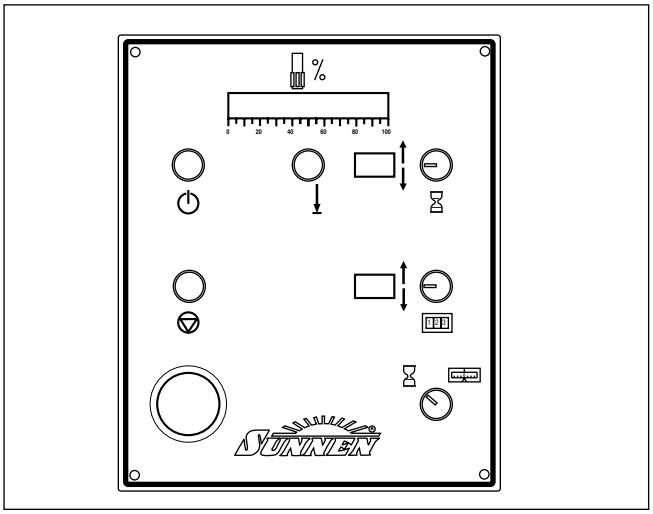


FIGURE 3-3, Operator Controls

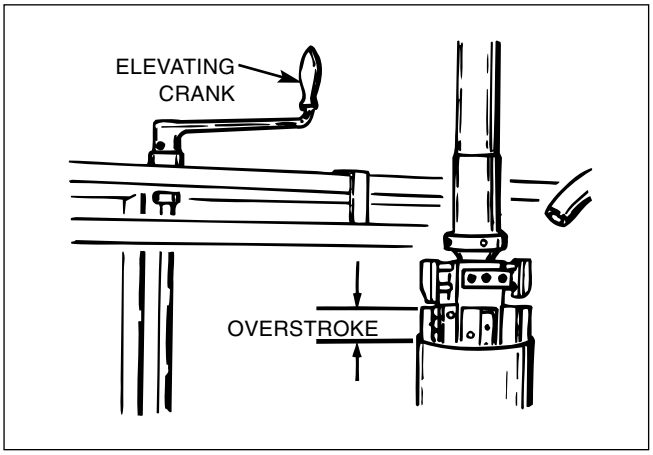


FIGURE 3-4, Elevating Crank

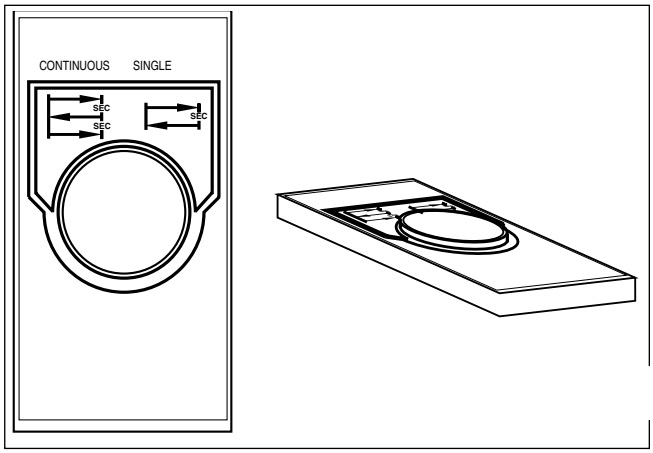


FIGURE 3-5, Dwell Controls

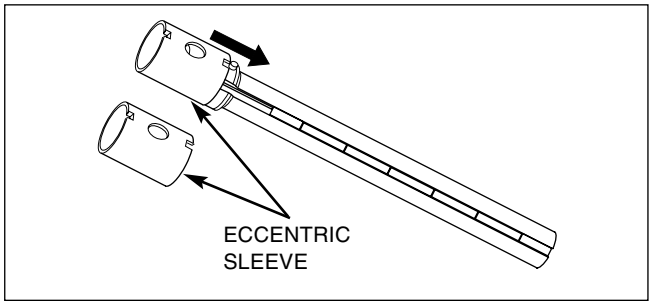


FIGURE 3-6, Eccentric Sleeve

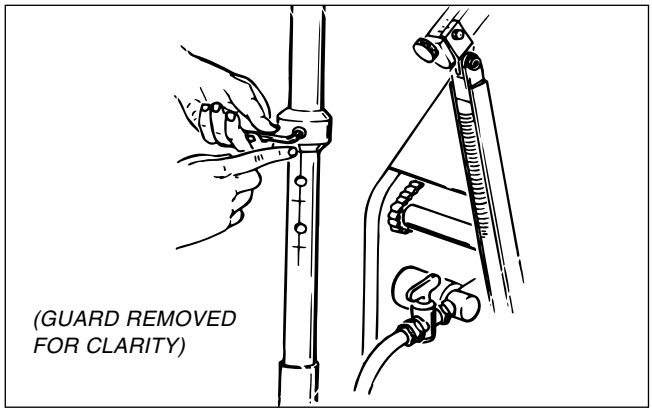


FIGURE 3-7, Install Mandrel Adapter

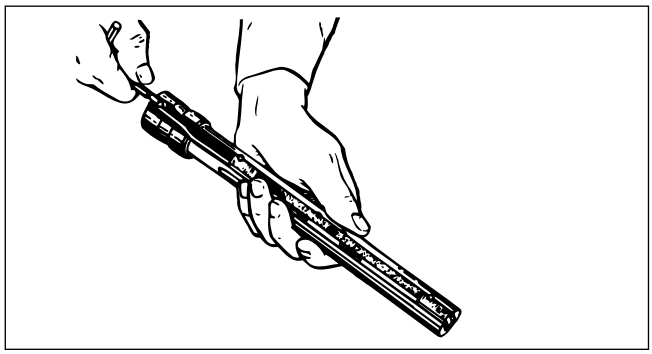


FIGURE 3-8, Mandrel Wedge

INDUSTRIAL APPLICATION – HINTS

If load is too high: Consistently over 90 points on the load meter, reduce rotational speed one step (see Figure 3-3). If lowest speed is being used and load is still too high, use a higher feed rate setting (to break down stone) or use a softer stone.

If the stone wears out too fast: Increase number of divisions used for easing in. Any starting load higher than the steady operating load will result in stone wear without accompanying stock removal.

If honing technique above does not result in greater stone life, use a lower feed rate setting.

If a low operating load accompanies the poor stone life, then increase rotational speed or use a harder stone.

If stock removal rates are too low: Increase rotational speed if the load can be kept in a safe area.

Increase "Strokes per Minute".
Use a higher feed setting.
Use a coarser stone.
Use a harder stone.

If bore is tapered, remove taper as follows: If bore is tight at bottom, raise workpiece with Elevating Crank (see Figure 3-4), or use dwell control button and dwell cycle switch (see Figure 3-5).

If bore is tight at top, lower workpiece.

If load is low and the hone head "wanders" up while dwelling, add a circular weight (four are provided with the machine) to the front of the Drive Arm (on top of Feed Handwheel).

Hints for good honing with Sunnen mandrels:
If workpiece gets bellmouthed during honing, shorten the stone only; do not shorten the shoe.
If workpiece gets barrel-shaped during honing, shorten the shoe only; do not shorten the stone.
If mandrel runout during honing is excessive, replace Concentric Sleeve on mandrel adapter with Eccentric Sleeve. If runout is still excessive, turn Eccentric Sleeve around (see Figure 3-6).

Hints for good honing with CV Tooling:
If hole is bellmouthed, shorten stroke.
If hole is barrel-shaped, lengthen stroke.
If stones wear tapered:
Check Alignment Guides for proper setting.
Check Main Guide #3 for taper. If guide is tapered, shorten Guide on thick end and place #1 Stones in the #2 position and vice-versa.

INDUSTRIAL APPLICATION – SETUP

When using CV Mandrel Adapter and Mandrel proceed with the following step, Installing CV Mandrel Adapter & Mandrel. When using CV Hone Head go to page 14, Installing CV Hone Head.

Installing CV Mandrel Adapter & Mandrel

1. Slide Drive Tube of Mandrel Adapter into Drive Tube of machine and tighten set screw in one of holes (see Figure 3-7).

2. Rotate Feed Handwheel to right until it stops, then rotate it one complete turn to left. This positions Feed Link of Mandrel Adapter to connect with mandrel wedge.

3. Rotate Mandrel Adapter until its Set Screw points toward you.

Install Mandrel

4. Insert stones into mandrel.

5. Pull wedge back with "V" notch in chuck wrench (see Figure 3-8).

6. Place Sleeve on mandrel if mandrel requires it (see Figure 3-9).

NOTE: Use Concentric Sleeve first. If runout during honing is excessive, replace with Eccentric Sleeve. If runout remains excessive, turn Eccentric Sleeve around.

---

7. Insert mandrel into Adapter (see Figure 3-10):

For all "Y" mandrels, and "P" mandrels under 66mm (2.6 in.): Stones should be facing 90° to right of Set Screw (as you face the machine).

For "P" mandrels over 66mm (2. 6 in.) diameter: Stones should be facing 90° to left of Set Screw.

8. Push mandrel up into Adapter until it bottoms, rotate it 1/4 turn to right, and push up until it bottoms again.

9. Tighten Set Screw securely with chuck wrench.

IMPORTANT

Test wedge hookup by rotating feed handwheel to right. Wedge should travel upward and stones retract. If not, loosen set screw and repeat steps 2 thru 6. Then check again until wedge does move up when handwheel is rotated to right.

---

10. Go to page 16, Machine Setup.

Installing CV Hone Head

1. Slide Drive Tube of Hone Head into Drive Tube of Machine and tighten locating screw in one of holes (see Figure 3-11). Note that locating screw can be screwed into holes in lower part of Drive Tube when index lines are in line.

Remove Worn-Out Stones

2. Slide Moveable Stop to OUT position (see Figure 3-12). Insert Stone Assembly with worn-out stone into fixture and pull lever toward you until stone is free from master stoneholder.

3. Brush chips and grit from Master Stoneholder slots; slide Moveable Stop to IN position; move lever to open position. Fixture is now ready for inserting new stone.

Install Stones

4. Move Lever to open position and slide Moveable Stop to IN position (see Figure 3-13).

5. Place Master Stoneholder in fixture as shown (see Figure 3-14). Brush all loose chips from Stoneholder grooves and slots.

6. Place Stone in Master Stoneholder (see Figure 3-15). Lugs on stone sides should fit into cross slots of Master Stoneholder.

7. Seat Stone in Master Stoneholder by pressing down with fingers (see Figure 3-16). Pull lever forward until Stoneholder hits the stop. Stone is now in place.

Install Guide/Stone Shims

8. Place Setting Gage in the bore to be honed; then snug, making sure to center (see Figure 3-17).

NOTE: On CK-3155 Setting Gage, make sure proper side of Turret faces Opening.

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9. Place Guide/Stone Assembly in Setting Gage with graduated slide set at "0" (see Figures 3-18 & 3-19).

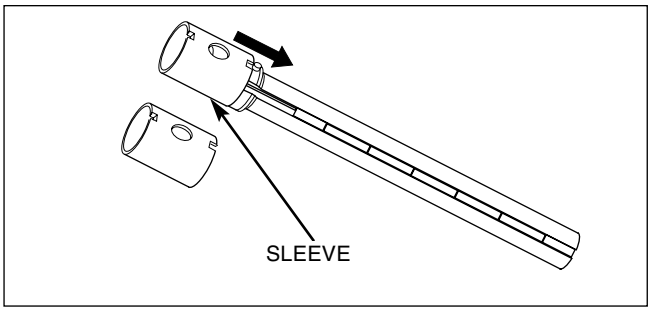


FIGURE 3-9, Sleeve

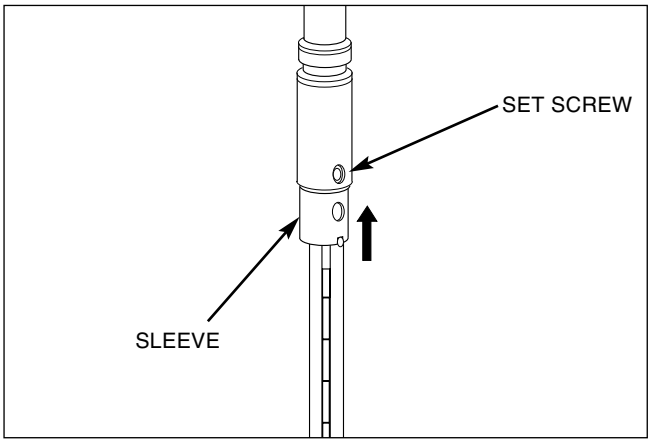


FIGURE 3-10, Install Mandrel

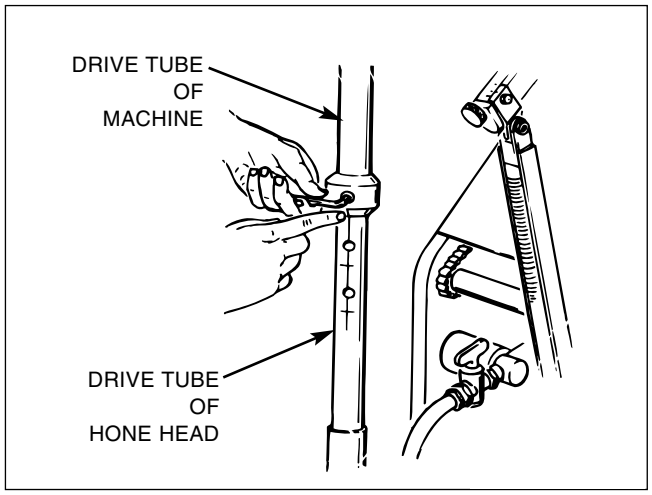


FIGURE 3-11, Install Hone Head

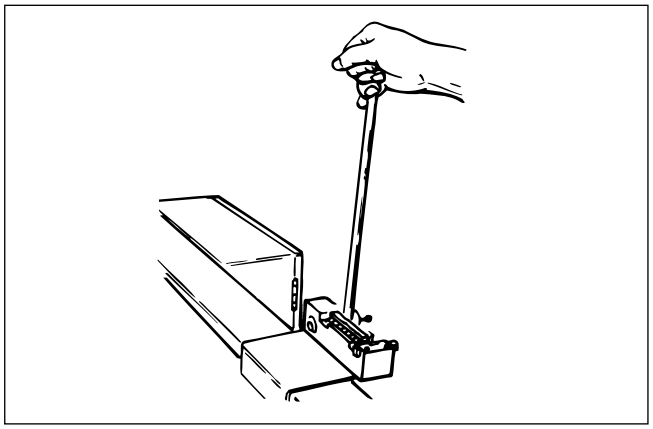


FIGURE 3-12, Remove Stones

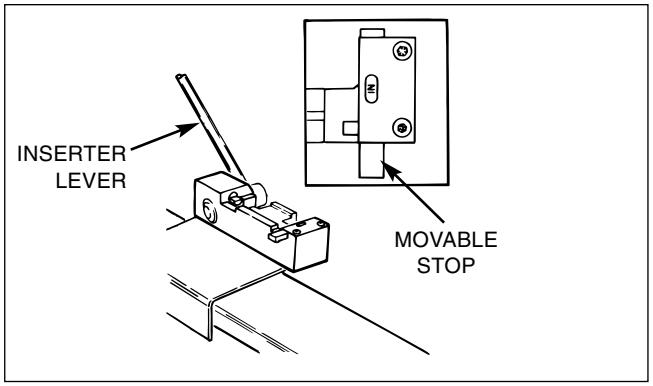


FIGURE 3-13, Open Position

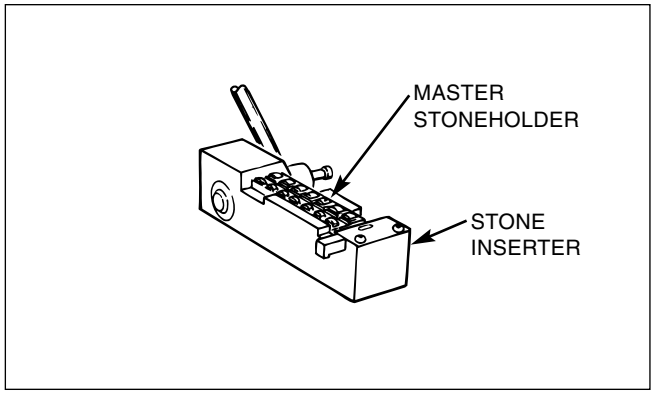


FIGURE 3-14, Master Stoneholder

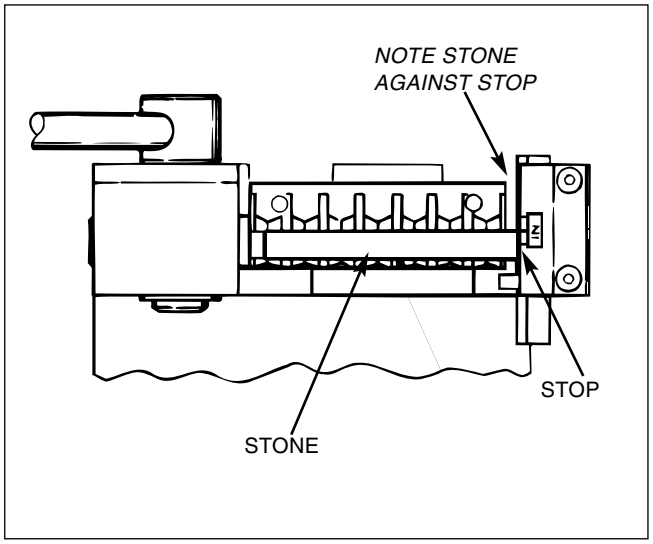


FIGURE 3-15, Install Stone

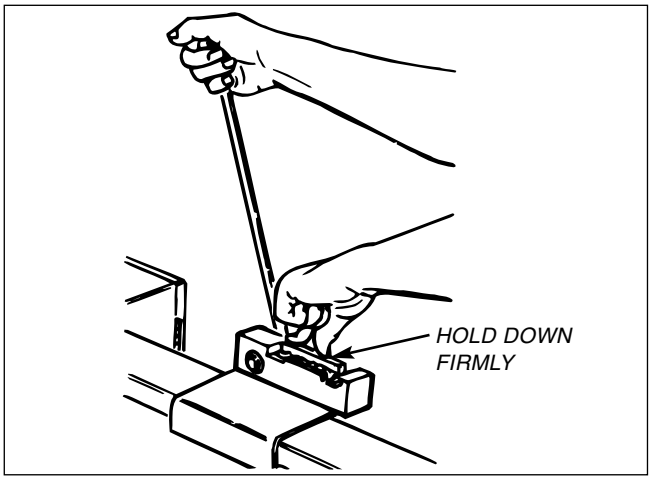


FIGURE 3-16, Seat Stone

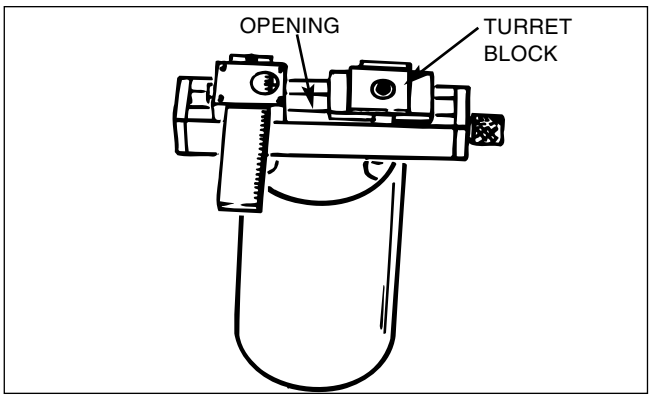


FIGURE 3-17, Setting Gage

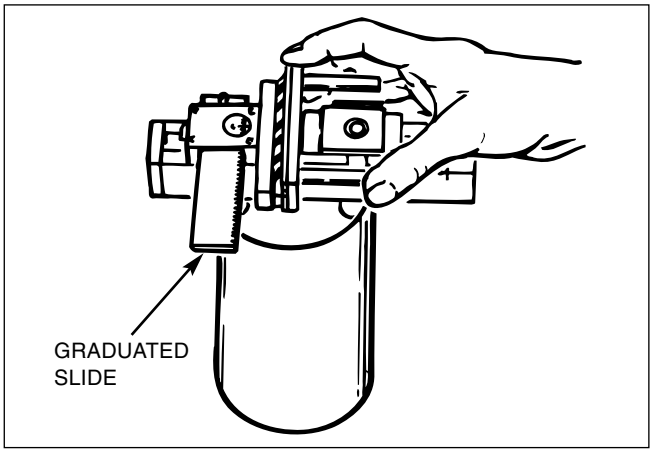


FIGURE 3-18, Stone Assembly

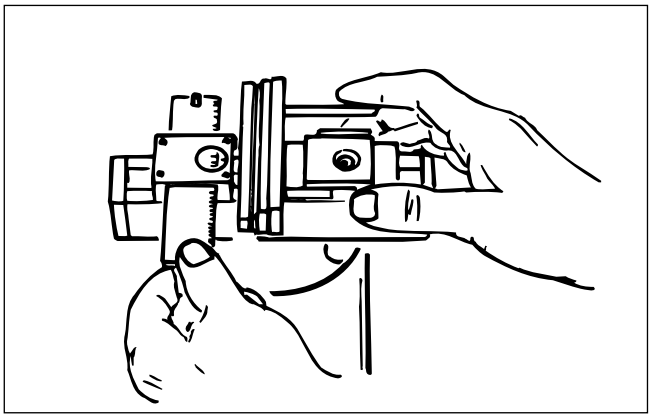


FIGURE 3-19, Main & Centering Guides

10. Move graduated slide so that pin contacts guide. If pin does not contact guide, add a No. 19 shim and try again. Now add necessary shims as indicated on slide. Looseness less than thickness of one shim is acceptable.

Special instructions for using CK-4155 Setting Gage for large hone head in 102-203 mm (4-8 in.) range. Move graduated slide so that pin contacts assembly. If graduated slide reads “15” or less, no additional shims should be added; if slide reads over “15”, remove assembly from Gage and add one shim.

NOTE: A properly shimmed assembly will slip into gage easily. Both Guide/Stone Assemblies must have same thickness of shims and each must fit in Setting Gage when assembled with shims.

11. Rotate Drive Tube until numeral “1” appears on Hone Body. Insert one stone assembly with shims in left-hand set of holes beneath numeral.

12. Insert other shimmed Stone Assembly beneath numeral “2”, using procedure above.

13. Insert shimmed Main Guide beneath numeral “3” on Hone Body.

NOTE: On CV-2400 and CV-4000 Hone Heads, Centering Guide and Main Guide are identical.

14. Place shimmed Centering Guide beneath numeral “4” on Hone Body.

Alignment Guide

NOTE: DO NOT use alignment guides when honing ported or keyway bores.

15. Place Alignment Guide in setting gage with graduated slide set at “0” (see Figure 3-20). Loosen Clamp Screw on alignment guide with hex key wrench and slide to Shoulder. Tighten Clamp and repeat procedure with second alignment guide.

16. Place one of alignment guides in left-hand set of holes above numeral “1” in hone body so guide and stone are in line.

17. Place other alignment guide in left-hand set of holes above numeral “2” in hone body so guide and stone are also in line.

Machine Setup

WARNING

Never attempt to adjust stroke length while machine is on or operating. Always close front guards before operating machine.

CE Lock front guards before operating machine

Set Stroke Length

1. Measure length of bore to be honed and length of honing stone.

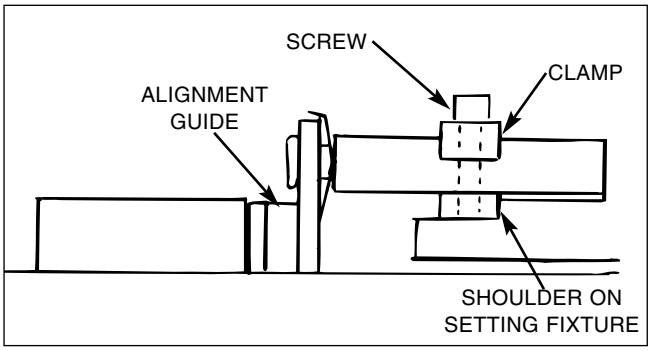


FIGURE 3-20, Alignment Guides

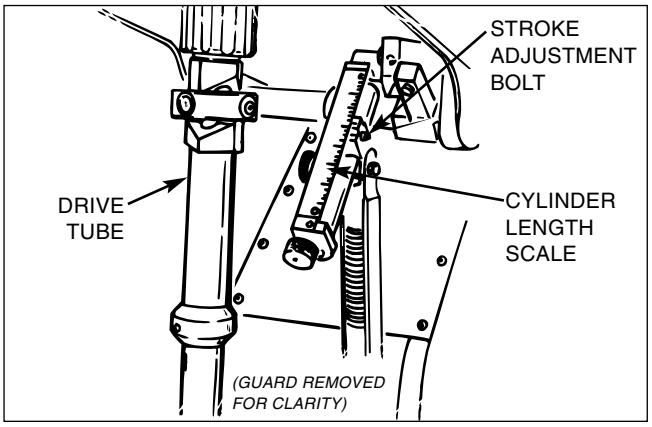


FIGURE 3-21, Stroke Length

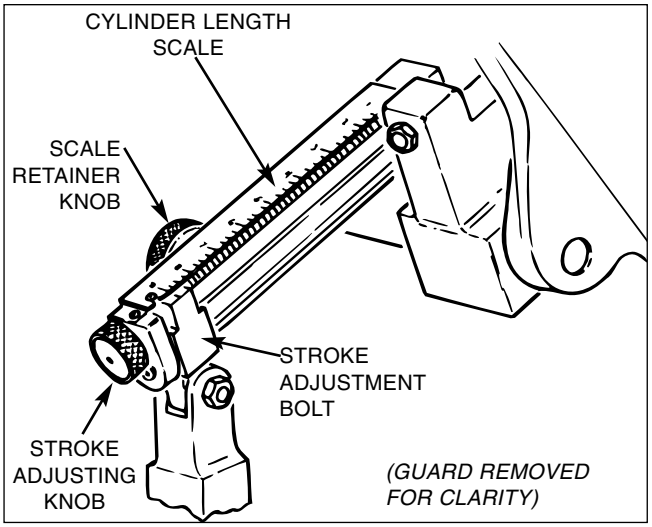


FIGURE 3-22, Stroke Adjustment

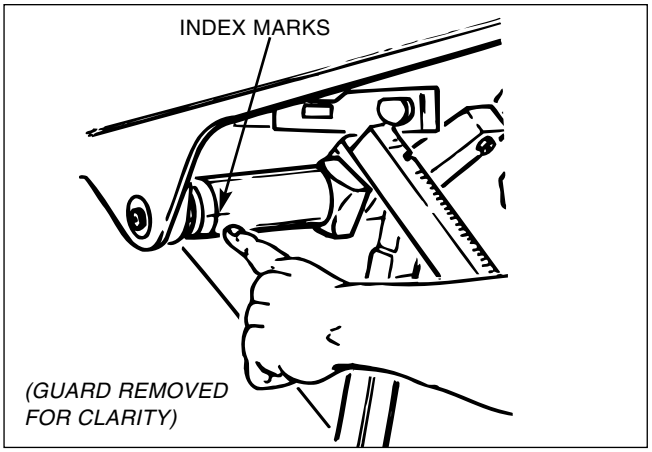
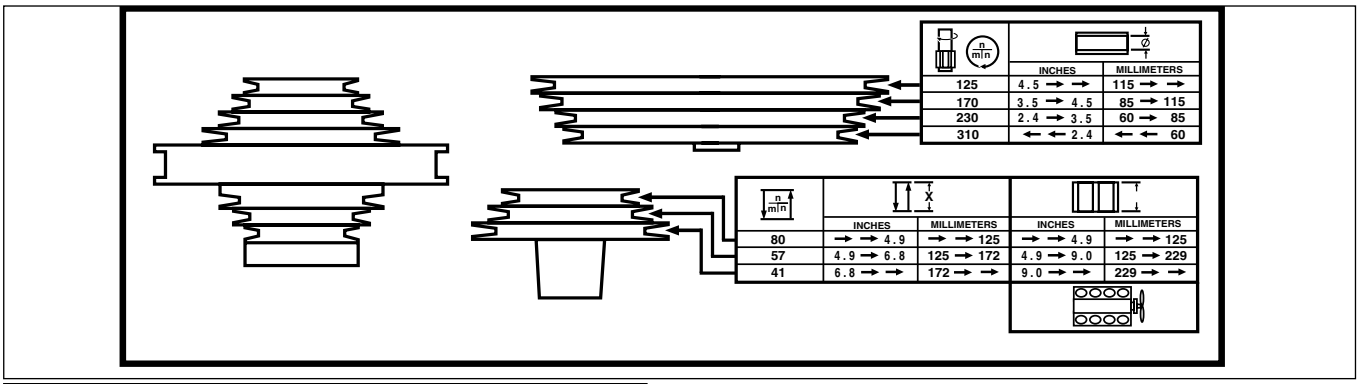


FIGURE 3-23, Stroke Position

TABLE 3-3, Spindle Speed & Stroke Rate



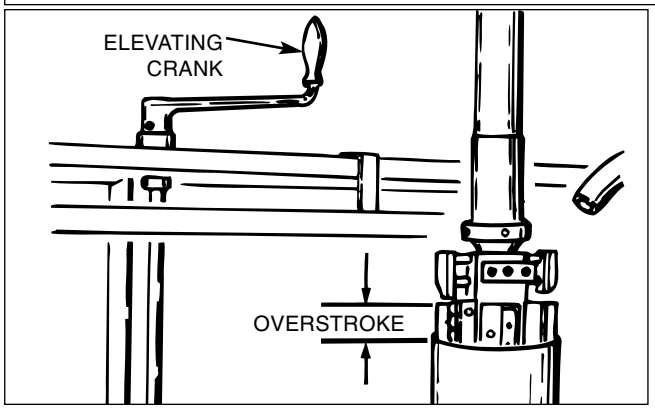


FIGURE 3-24, Overstroke

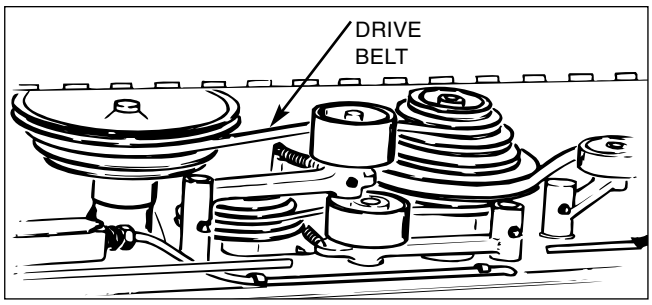


FIGURE 3-25, Drive Belt

The longer of the measurements is the desired stroke length. However, It may be necessary to use less than desired stroke length if:

- The desired stroke length is longer than 228 mm maximum (9 in.), which is machine limit; or
- The mandrel shank is not long as Main Guide; or
- Cutouts or thin walls near end of bore threaten stability of honing tool end of a long stroke; or
- Honing with CV Hone Head has resulted in bellmouth beyond straightness tolerance required in workpiece.

Maximum stroke length for blind holes is bore length minus 1/2 stone length.

2. Rotate feed handwheel to right and squeeze stones together until they are completely retracted.

Push centering guide against spring loaded pin so that hone head will fit into cylinder.

3. Lower assembled hone head into cylinder to be honed by using lift lever.

4. Open both side guards.

5. If necessary, rotate Drive Tube until Stroke Adjustment is easily seen (see Figure 3-21).

6. Loosen Stroke Adjustment Bolt and turn Stroke Adjusting Knob so that index mark lines up with desired stroke length on graduated scale (see Figure 3-22). Tighten Stroke Adjustment Bolt.

Set Stroke Position/Overstroke

NOTE: Overstroke is the amount that stone sticks out of bore.

7. Use the following formula to determine top overstroke. Bottom overstroke is equal to top overstroke except for blind holes.

For normal holes:

$$\text{Overstroke} = \frac{\text{Stroke length} + \text{Stone length} - \text{Bore length}}{2}$$

For blind holes:

$$\text{Overstroke} = \text{Stroke length} + \text{Stone length} - \text{Bore Length}$$

8. Rotate Drive Tube until Hone Head is in its uppermost position and index marks are aligned (see Figure 3-23).

9. Use Elevating Crank (see Figure 3-24) to position workpiece so stone extends above top of bore the amount determined in Step 7.

10. If Elevating Crank will not raise or lower workpiece sufficiently to produce required top overstroke, loosen Set Screw in Drive Tube and adjust length of drive tube as required. Then, tighten set screw.

The Set Screw should be screwed into hole in lower part of drive tube when index lines are in line.

11. Check setup by rotating Drive Tube by hand to cycle machine through one complete stroke.

Set Spindle Speed and Stroke Rate (SPM)

12. Measure bore diameter and length to nearest 1 mm (1/6 in.). Then select proper spindle speed and stroke rate from chart on inside of belt cover (see Table 3-3).

13. Open left-hand side of belt cover.

14. Shift Drive Belt to position for desired spindle speed (see Figure 3-25).

15. Shift Stroke Belt to position for desired stroking rate.

16. Close belt cover.

CE Lock belt cover before attempting to operate. This cover is interlocked, and machine will not operate with cover in the open position.

Set Feed Rate

WARNING

Never attempt to adjust feed rate while machine is on or operating. Always close front guards before operating machine.

CE Lock front guards before operating machine

17. Set Selector Cover. Rotate Selector Cover, not knob (see Figure 3-26).

For rough honing, set Selector Cover to “6”.

For finish (most) honing, set Selector Cover to “4”.

For faster stock removal or rougher finish, use a higher number.

For greater stone life or smoother finish, use a lower number.

18. Set Feed Dial Index Plate to indicate Honing Tool being used (see Figure 3-27).

NOTE: Index Plate has two sides. Slide Plate from holder and invert if correct tooling is not shown on side being observed.

Measuring Taper

19. Gage Bore. Determine amount of stock removal required. If you are rough honing, plan to leave 0,08 mm (.003 in) for finish honing (see Figure 28).

Check for bore straightness by gaging top, middle and bottom of bore.

The difference in highest and lowest readings is the taper to be removed.

20. Reset Dial Bore Gage so “0” is desired finished size.

INDUSTRIAL APPLICATION – OPERATION

Read the rest of the instructions to become familiar with correct honing procedure before starting machine.

Hone First Bore

1. Gage Bore. Determine amount of stock removal required. If you are rough honing, plan to leave 0,08 mm (.003 in.) for finish honing.

As an example, we will assume 0,18 mm (.007 in.) of stock needs to be removed.

2. Rotate Feed Handwheel to right to retract the stones.

3. Squeeze stones together, push centering guide against spring-loaded pin, and lower hone head into bore to be honed (see Figure 3-29).

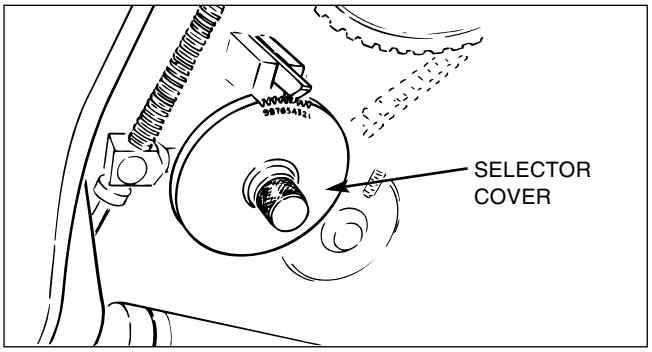


FIGURE 3-26, Feed Rate

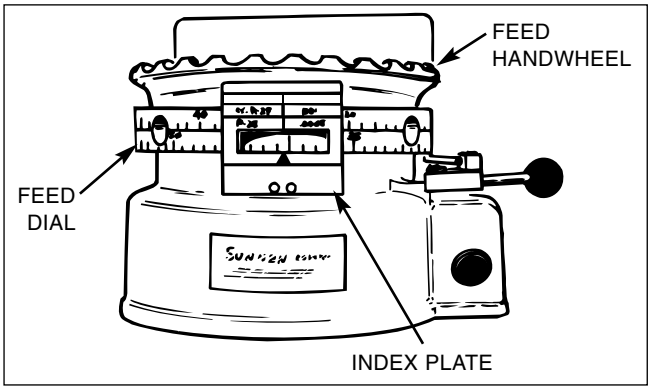


FIGURE 3-27, Feed Dial

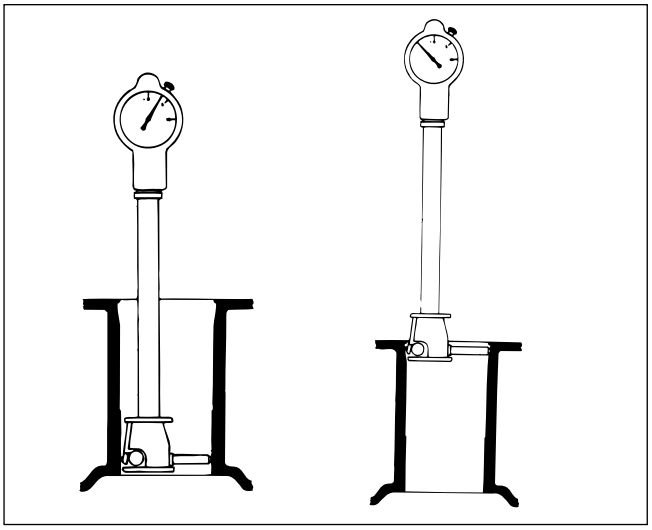


FIGURE 3-28, Gage Bore

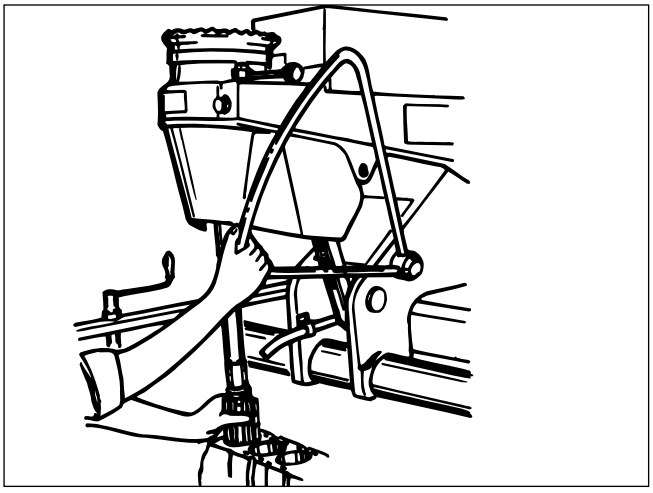


FIGURE 3-29, Insert Stones

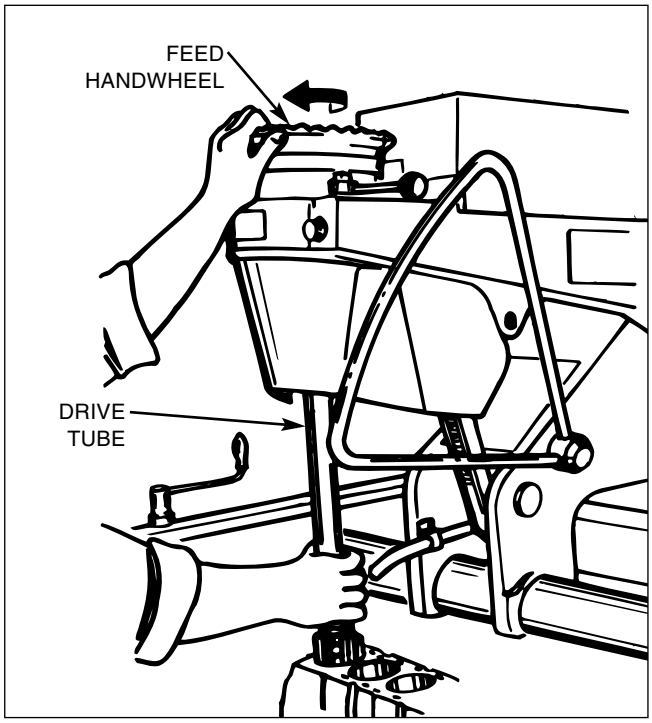


FIGURE 3-30, Feed Handwheel

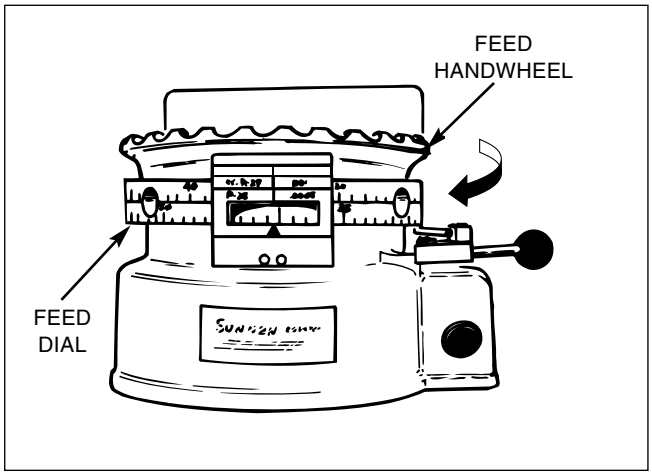


FIGURE 3-31, Feed Dial

4. Rotate Feed Handwheel to left until snug (a slight resistance is felt); shake Drive Tube to seat stones (see Figure 3-30).

5. Slide Feed Dial to left until desired stock removal is shown in Index Plate (see Figure 3-31).

Feed Dial can slide to right on Feed Handwheel. Adjust Feed Dial for amount of stock to be removed. In our example you would move Feed Dial – Feed Handwheel does not move – until it shows 18 for metric machines (7 for domestic machines).

If there were no stone wear, machine would hone bore to size without any additional adjustment. However, there is stone wear, and you must compensate for it on each cylinder if you are going to "hit size".

As a place to start, assume that 2 units of stock are removed for every 1 unit of stone worn away. If you are finish honing, ratio will be closer to 1 to 1.

NOTE: Do not assume any stone wear if you are using Sunnen metal bonded diamond stones.

Example:

STOCK TO BE REMOVED ESTIMATED STONE WEAR
.007 x I/2 = .0035"
STONE WEAR TO STOCK REMOVAL RATIO
0,18mm x 1/2 = 0,09mm
STOCK TO BE REMOVED ESTIMATED STONE WEAR

Adjust Feed Dial to right for amount of estimated stone wear, that is, 9 marks for metric machines (3-1/2 marks for domestic machines).

You should now read 27 on Feed Dial for metric machines (10-1/2 for domestic machines). This will be referred to as base number throughout these instructions. The base number is always the sum of stock to be removed, added to expected stone wear.

Example:

.0070	(0,18 mm)	STOCK TO BE REMOVED
+.0035	(0,09 mm)	ESTIMATED STONE WEAR
.0105	(0,27 mm)	BASE NUMBER

Base number is the number that must be represented on Feed Dial when machine is first at full load.

6. Rotate Feed Handwheel to right 5 to 10 marks as shown on Feed Dial. Push in on Clutch Control Lever to start motors, and then carefully pull lever fully forward.

Without hesitating after Step 5 above, rotate Feed Handwheel to left until load meter reads 80 (60 for finish honing) or more.

Start Machine:

7. Raise Disconnect Switch on Main Control Panel.

8. Set Mode Switch to Zero Shutoff or Timed.

Timed: Machine will hone until the number of seconds on Honing Time display reaches zero and head is at top of stroke. Zero Shutoff: Machine will hone until zero is reached on graduated feed dial and head is at top of stroke.

9. Rotate E-Stop Button to release.

10. Push white Power ON Button.

WARNING

Front splash guard must be raised to uppermost position before operating machine.

CE Front splash guard is interlocked and machine will not operate if guard is not in uppermost position.

11. Raise front panel splash doors.

WARNING

Push Clutch Control Lever – DO NOT pull Clutch Control Lever forward.

12. Push Clutch Control Lever toward rear of drive arm to start motors (see Figure 3-32).

13. Direct Oil Nozzle so that bore receives good flow of oil. Open oil Shutoff Valve.

14. If taper was evident when gaging the bore in step 1, set Dwell Cycle to required number of dwells. Approximately one dwell is required for each 0,025 mm (.001 in.) of taper, as determined in setup (see Figure 3-33).

NOTE: Make sure outer ring of Dwell Control is set at SINGLE (see Figure 3-34).

WARNING

DO NOT pull Clutch Control Lever forward to engage drive belt unless hone head is in bore.

15. Pull Clutch Control Lever forward slowly but steadily until it hits stop. This action engages main drive belts.

NOTE: Machine will shut off automatically when feed dial and feed handwheel move to “0” in zero shutoff mode, or when honing time display reads “0” in timed mode.

16. Observe Honing Load Meter to check cylinder straightness after dwell cycle stops (see Figure 3-35).

The meter's display is calibrated at factory to display zero load when machine is stroking with no honing load, and 100% when machine is running at its two horsepower limit.

If display “swings” more than 10 points (i.e., difference between position of “bar” and “dot” is more than 10 points), and yellow light flashes when bar moves to right (in direction of increasing load), push dwell control button to remove taper. Repeat as necessary to decrease distance between bar and dot as much as possible. If a considerable number of dwells are required, increase number of dwells for next cylinder (see Figures 3-34 & 3-36).

If load display “swings” more than 10 points (i.e., difference between position of “bar” and “dot” is more than 10 points), and yellow light flashes when bar moves to left (in direction of decreasing load), wait several strokes to see if distance between bar and dot decreases. If load continues to vary by more than 10 points, rotate Elevating Crank one turn counterclockwise to lower workpiece. When load display settles back to less than a 10 point swing, raise block back to its original position. If engine block required lowering, decrease number of dwells for next cylinder (see Figures 3-37 & 3-38).

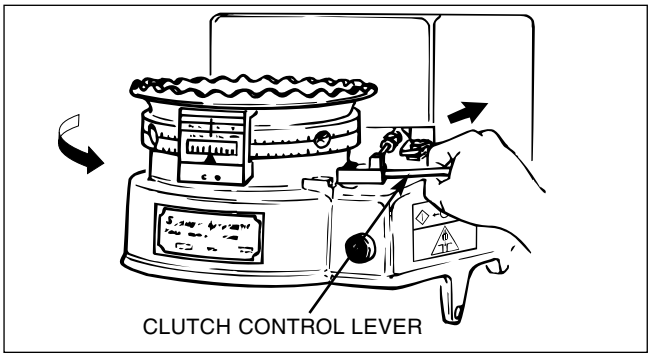


FIGURE 3-32, Clutch Control Lever

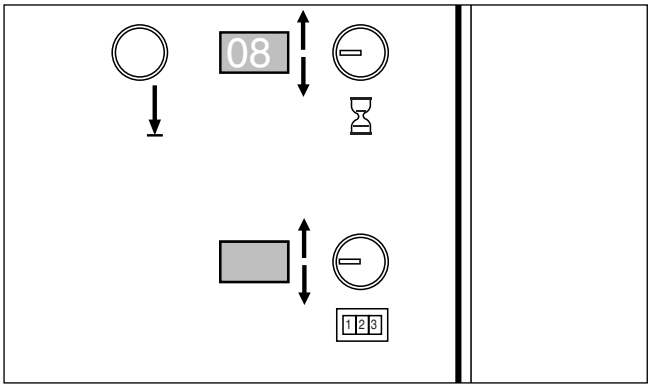


FIGURE 3-33, Dwell Cycle

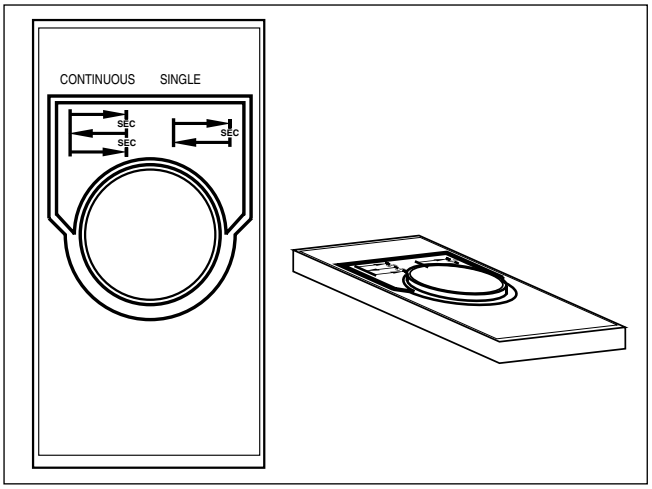


FIGURE 3-34, Dwell Control

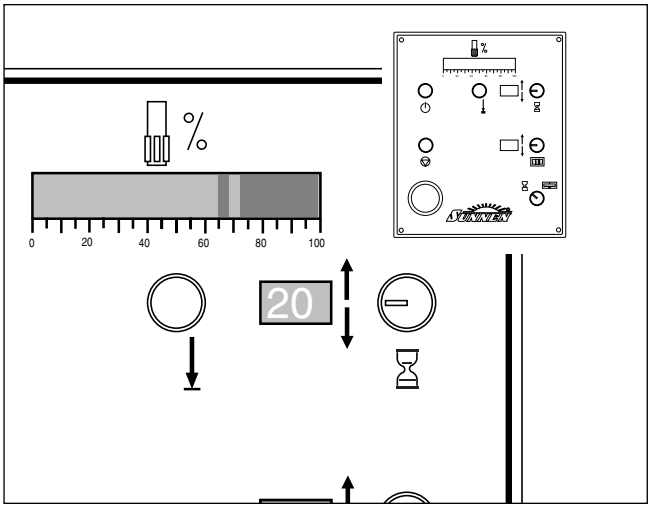


FIGURE 3-35, Honing Load Meter

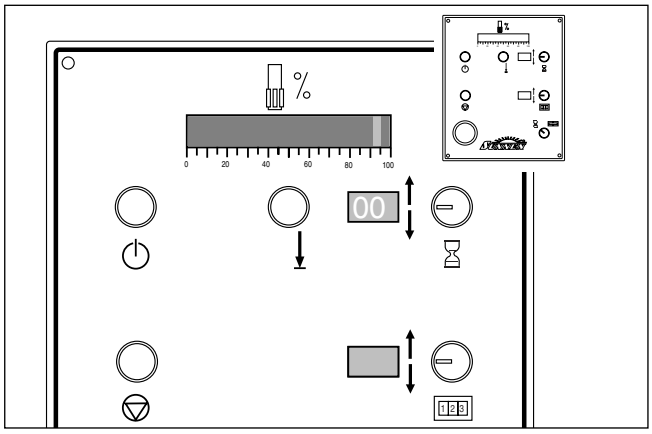


FIGURE 3-36, Dwell

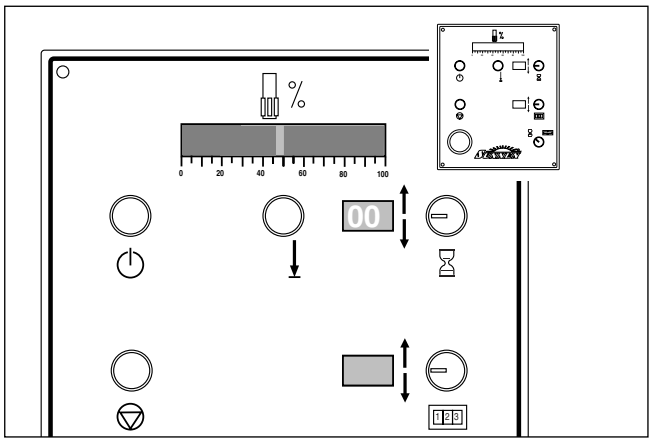


FIGURE 3-37, Dwell

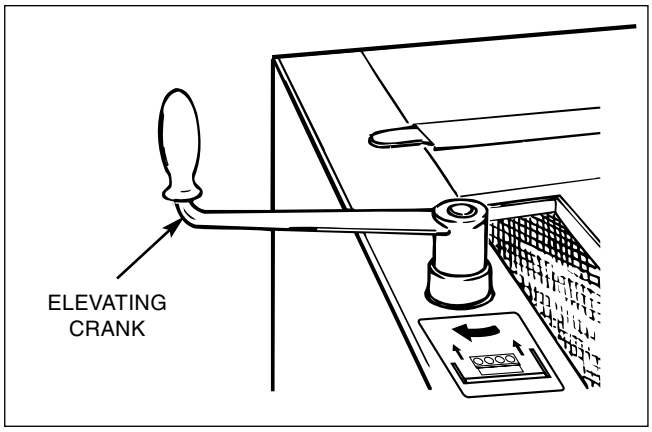


FIGURE 3-38, Dwell

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to "0". In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

17. Push Clutch Control Lever back lightly to release Feed Handwheel. (When Clutch Control Lever is pushed back too far, it will start motors; if this happens, push Emergency Stop Button on Remote Control Panel.)

18. Rotate Feed Handwheel to right to release stone pressure. DO NOT slide feed dial in relation to handwheel.

19. Lift Control Lever to remove Hone Head from bore.

20. Gage bore. Bore should be undersize at this point.

21. Place Honing Tool back into bore, squeezing guides to enter bore.

22. Rotate Handwheel to left until lightly snug. Note number on Feed Dial.

23. Hold Handwheel firmly and slide Dial to right number of divisions that gage showed undersize in step 20.

24. Rotate Handwheel to right a few divisions to release stone pressure.

25. Start motors and engage drive belt Clutch Control.

26. Ease Handwheel to left until Dial indicates amount of stock removal needed.

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to "0". In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

27. Repeat Steps 15 thru 26 until FIRST BORE is within size tolerance.

IMPORTANT

At this point, automatic shutoff has been set. Stone breakdown will be determined while honing second bore. Use Table 3-4, on page 22, while honing second bore to help determine stone breakdown.

28. Adjusting Feed For Bore Being Honed

When last bore was under or oversize, add amount last bore was under or oversized to estimated stone wear for amount. Add to this, difference between original and new stone wear estimate for stock removal in present bore. This is amount you should slide Feed Dial. You will have a new stone wear estimate only if you had to recalculate your stone wear ratio.

Example:

AMOUNT OVER OR UNDER SIZED (FROM LAST BORE)		1.0
STONE WEAR FOR THIS AMOUNT (1 x 3/4 = 3/4 ROUNDED DOWN)		0.5
NEW STONE WEAR ESTIMATE (7 x 3/4 = 5-1/4 ROUNDED DOWN TO 5)	5.0	
ORIGINAL STONE WEAR ESTIMATE (7 x 1/2 = 3-1/2)	3.5	
DIFFERENCE BETWEEN NEW AND ORIGINAL STONE WEAR ESTIMATES (5 – 3-1/2 = 1-1/2)		1.5
TOTAL		3.0

If last bore was undersize, hold Feed Handwheel still and slide Feed Dial to right number of marks you calculated. In our example it would be 3.

TABLE 3-4, Setup Chart

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
NUMBER	PART LENGTH	STROKE LENGTH	STONE LENGTH	OVERSTROKE	RPM	STROKES PER MINUTE	STONE	FEED RATE SETTING	STOCK REMOVAL	FEED HANDWHEEL MOVEMENT (DIVISIONS)					UNDERSIZE or (OVERSIZE) After Honing	REMARKS
										STOCK REMOVAL deduct Undersize or add Oversize from Col. 16	ANTICIPATED STONE BREAKDOWN	add Undersize or deduct Oversize from Col. 16	EASING IN	TOTAL of Col. 11, 12, 13 & 14		
											SLIDE FEED DIAL			START		
									.010	10-0=10	0	0	2	12	.003	
									.003	3-3=0	0	3	0	3	.001	
									.001	1-1=0	0	1	0	3	.001	
												4				Use this for anticipated stone breakdown for part # 3.
									.010	10-0=10	4	0	0	16	.000	
									.010	10-0=10	4	0	0	16	(.001)	.001 oversize. Too much anticipated stone breakdown.
									.010	10+1=11	3 1/2	-1	0	15 1/2	.000	
									.012	12-0=12	4	0	0	18	.0005	.0005 undersize. But still in tolerance.
									.012	12-1/2=11 1/2	4 1/2	+1/2	0	18 1/2	.000	

If you were oversize, hold Feed Handwheel still and slide Feed Dial to left number of marks you calculated. In our example it would be 3.

Hone Second Bore

l. Gage Bore to determine amount of stock to be removed.

2. Place Honing Tool into bore.

3. Rotate Feed Handwheel to left until snug. DO NOT slide feed dial in relation to handwheel.

4. Advance Feed Dial number of divisions that you anticipate for stone wear. Remember to hold Handwheel firmly.

Adjust Feed Dial for amount of stock to be removed; plus, you must compensate for stone wear.

Stone wear is equal to total number of divisions that Feed Dial is advanced when honing second bore to size.

As a place to start, assume that 2 units of stock are removed for every 1 unit of stone worn away. If you are finish honing, ratio will be closer to 1 to 1.

NOTE: Do not assume any stone wear if you are using Sunnen metal bonded diamond stones.

5. Release stone pressure.

6. Push Clutch Control Lever toward rear of drive arm to start motors; then, pull Lever forward to engage drive belt.

IMPORTANT

Note starting position on graduated Feed Dial. Stone Breakdown is equal to total number of divisions that Feed Dial is advanced when honing second bore to size.

7. Ease Handwheel to left until Dial indicates amount of stock removal needed.

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to “0”. In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

8. When machine shuts off, remove Honing Tool and Gage Bore.

Repeat steps 2 thru 8 until SECOND BORE is within tolerance. Follow rest of example on Setup Chart for remaining bores (refer to Table 3-4). Setup Chart blanks can be obtained through Customer Service Dept.

NOTE: Once bore has a honed surface, there is no need to allow feed-up for easing in.

Hone Third & Subsequent Bores

1. Gage Bore to determine amount of stock to be removed.

2. Place Honing Tool into bore.

3. Rotate Handwheel to left until snug. DO NOT slide feed dial in relation to handwheel.

4. Advance Dial number of divisions that you anticipate for stone breakdown. If stock to be removed in third bore is same as for second bore, stone breakdown should be same.

5. Release stone pressure.

6. Push Clutch Control Lever toward rear of drive arm to start motors; then, pull Lever forward to engage drive belt.

7. Ease Handwheel to left a few divisions.

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to “0”. In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

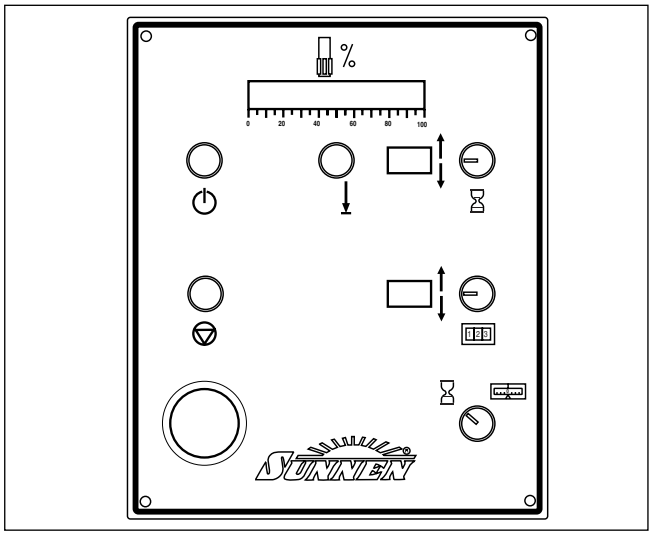


FIGURE 3-39, Operator Controls

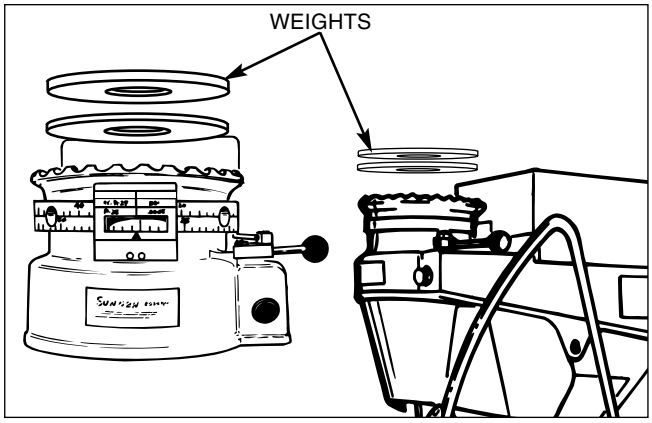


FIGURE 3-40, Circular Weights

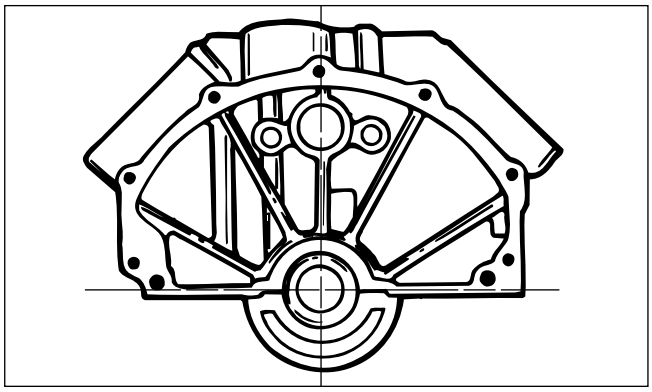


FIGURE 3-41, Main Bearing Centerline

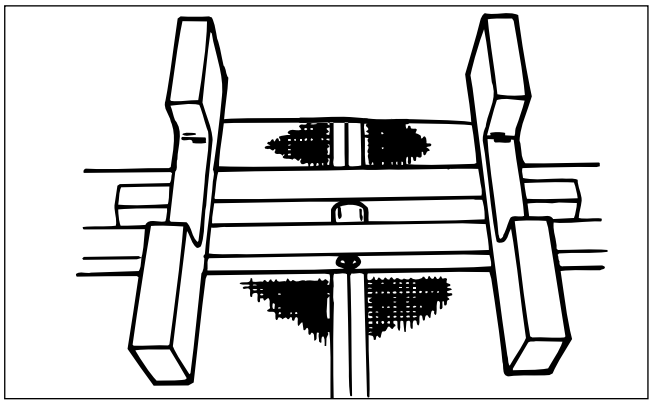


FIGURE 3-42, Riser Blocks

8. When machine shuts off, remove Honing Tool and Gage Bore.

If stone wear was correctly anticipated, THIRD BORE will be within size tolerance. Modify anticipated stone breakdown figure as required to keep subsequent bores within size tolerance. Follow rest of example on Setup Chart for remaining bores (refer to Table 3-4). Setup Chart blanks can be obtained by asking for Form No. X-CV-5016.

AUTOMOTIVE APPLICATION – HINTS

If load is too high: Consistently over 90 points on load meter (see Figure 3-39). Make stones feed slower by setting selector cover to a lower number, or use a softer stone.

If stone wears too fast: Start honing operations with a lower load. load should always be applied after rotation has started. Any load higher than steady operating load will result in faster stone breakdown.

If starting honing operation at lower load does not result in greater stone life, set selector cover to lower number.

Use harder stones. If a low operating load accompanies poor stone life (less than 60 points on roughing or less than 20 points for finishing), then increase rotational speed (RPM).

If stock removal rates are too low: Increase rotational speed if load can be kept in a safe area. Set selector cover to higher number.

Use softer stones. If load is low and hone head *wanders* up and down while dwelling, add a circular weight (six are provided with machine) to front of drive arm (inside feed handwheel) (see Figure 3-40).

When honing blind, tapered, or “choke” aircraft cylinders, write to Sunnen Products Company for special instructions.

If one stone wears faster than other, move stone that is in Position 1 to Position 2. Move stone that is in Position 2 to Position 1.

If guides wear tapered, shorten guide by removing l/4 inch (about 10mm) from thick end.

If stones wear tapered, check adjustment of alignment guides with setting gage.

If part is out-of-round: Check setting of main guide, using setting gage.

Reduce honing load by using softer stones or by setting selection cover to a lower number.

AUTOMOTIVE APPLICATION – SETUP

Loading Engine Blocks into Machine

1. Positioning Riser Blocks for In-line and V-Blocks.

If engine block’s main bearing centerline is in line with its pan rails (see Figure 3-41), position Riser Blocks upward (see Figure 3-42).

If main bearing centerline is above pan rails (see Figure 3-43), turn Riser Blocks to down position (see Figure 3-44).

2. Clamping Engine Block in Place (In-line and V-blocks).

NOTE: At least two end bearing caps must be bolted in place. Distortion will be kept to a minimum if all main bearing caps are installed and torqued properly.

Place Clamp Bar through main bearing bores (see Figure 3-45).

Move carriage to left and raise drive arm.

Make sure that pan rails do not have any gasket material or dirt on them.

Slide riser blocks to approximate position near ends of engine block.

Place engine block on riser blocks near center of Cradle (see Figure 3-46).

Slide Clamps to slots in Clamp Bar (see Figure 3-47). It may be necessary to shift position of engine block so that both Clamps will slide into slots of Clamp Bar.

With both Clamps in position, tighten clamp nuts evenly – first by hand and then with Clamp Crank – so that engine block is held firmly to Cradle. In-line Engine Blocks are now in a position to be honed.

3. Positioning V-Blocks. Release cradle index latch at right end of Cradle, and rotate Cradle and engine block to position for honing (see Figure 3-48). first notch from center position is for 60° V-blocks; second notch is for 90° V-blocks. “V” Engine Blocks are now in a position to be honed.

Installing CV Hone Head

1. Slide Drive Tube of Hone Head into Drive Tube of Machine and tighten locating screw in one of holes (see Figure 3-49). Note that locating screw can be screwed into hole in lower part of Drive Tube when index lines are in line.

Remove Worn-Out Stones

2. Slide Moveable Stop to OUT position (see Figure 3-50). Insert Stone Assembly with worn-out stone into fixture and pull lever toward you until stone is free from master stoneholder.

3. Brush chips and grit from Master Stoneholder slots; slide Moveable Stop to IN position; move lever to open position. Fixture is now ready for inserting new stone.

Install Stones

4. Move Lever to open position and slide Moveable Stop to IN position (see Figure 3-51).

5. Place Master Stoneholder in fixture as shown (see Figure 3-52). Brush all loose chips from Stoneholder grooves and slots.

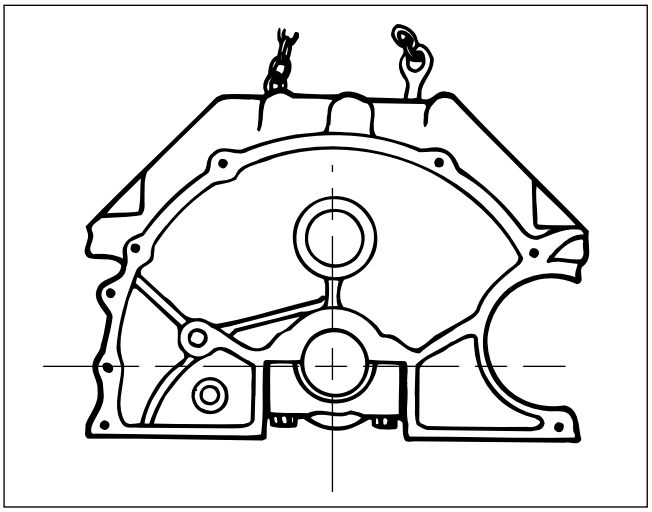


FIGURE 3-43, Main Bearing Centerline

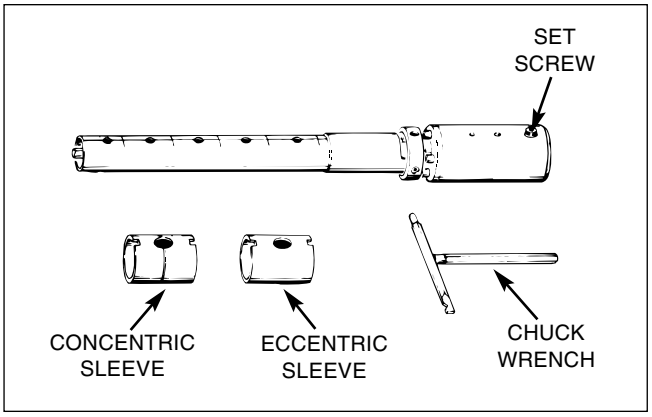


FIGURE 3-44, Riser Blocks

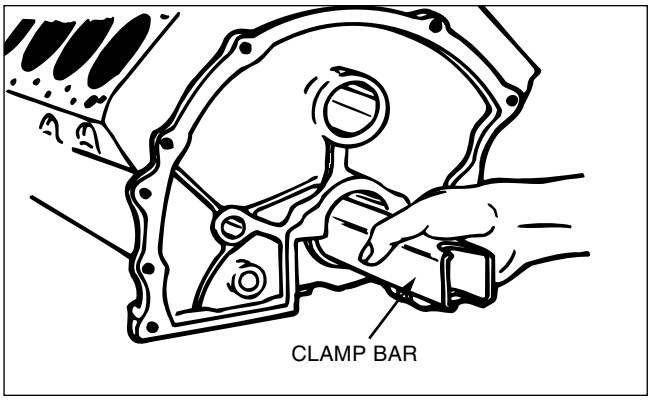


FIGURE 3-45, Clamp Bar

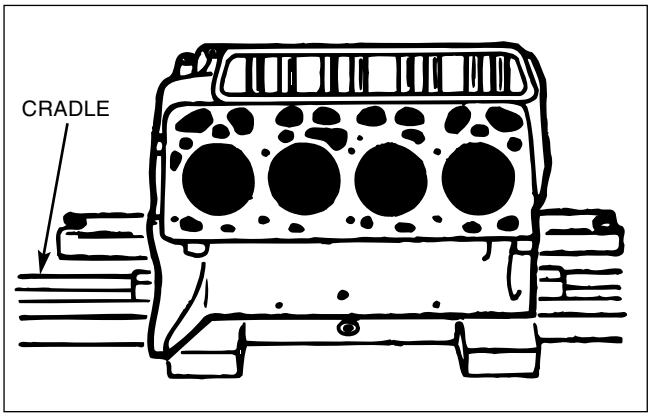


FIGURE 3-46, Position Block

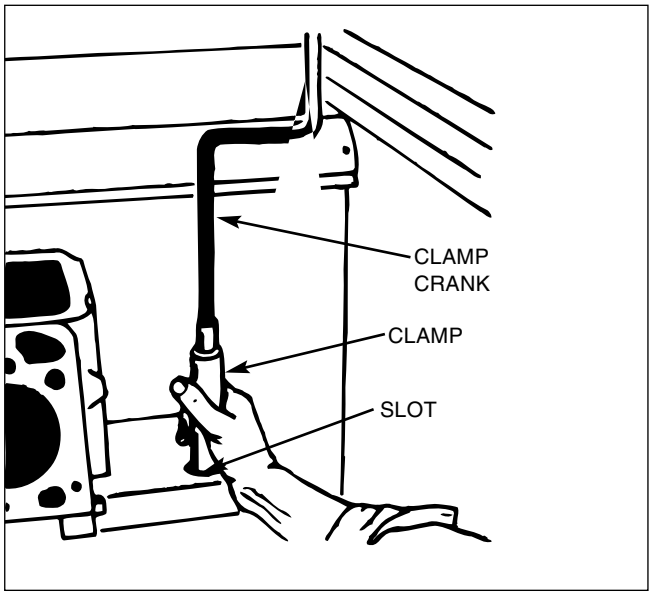


FIGURE 3-47, Clamping

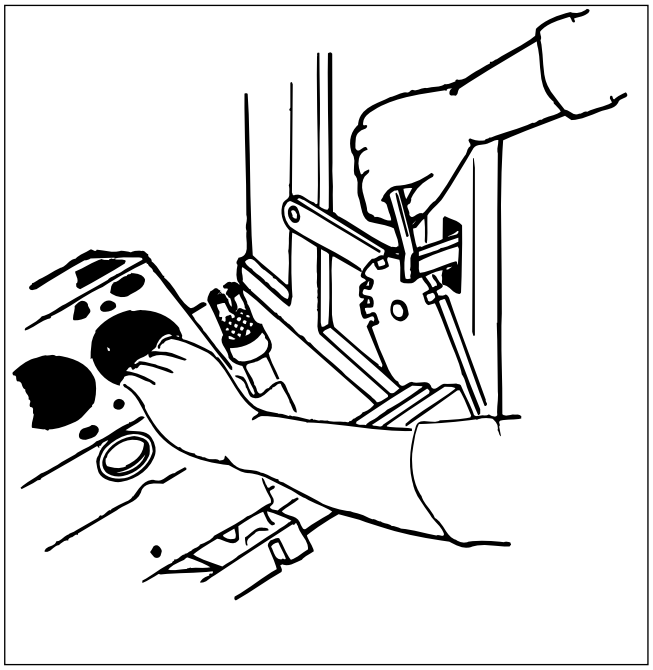


FIGURE 3-48, Rotate Cradle

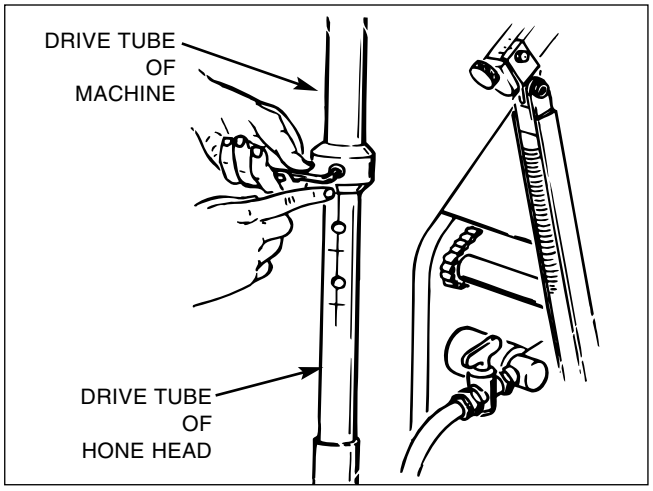


FIGURE 3-49, Install Hone Head

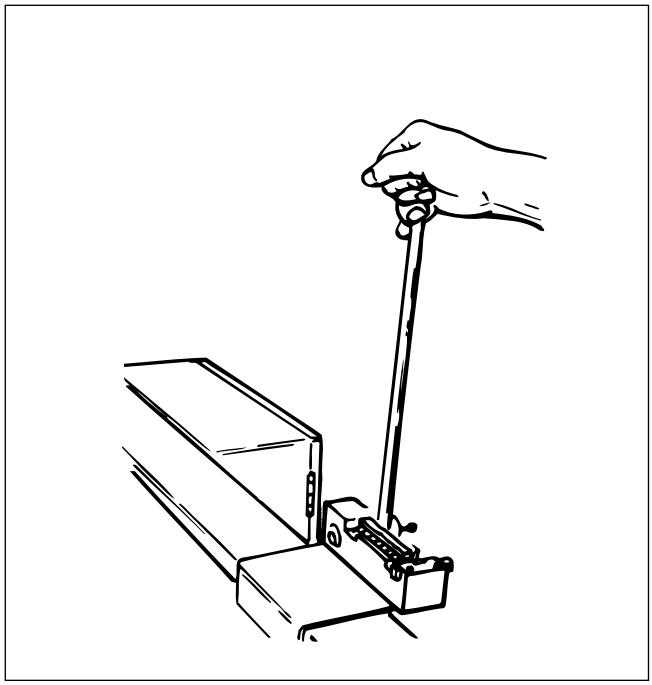


FIGURE 3-50, Remove Stones

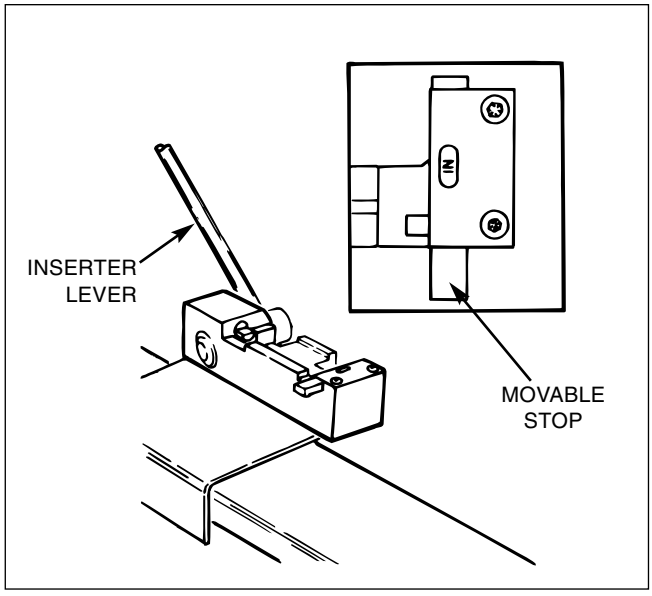


FIGURE 3-51, Open Position

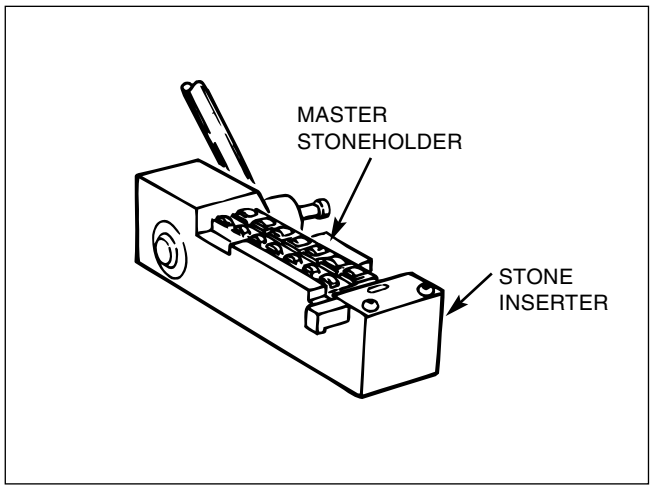


FIGURE 3-52 Master Stoneholder

6. Place Stone in Master Stoneholder (see Figure 3-53). Lugs on stone sides should fit into cross slots of Master Stoneholder.

7. Seat Stone in Master Stoneholder by pressing down with fingers (see Figure 3-54). Pull lever forward until Stoneholder hits stop. Stone is now in place.

Install Guide/Stone Shims

8. Place Setting Gage in one of cylinders to be honed and snug, making sure to center. Make sure proper side of Turret Block faces opening for honing head being used (see Figure 3-55).

9. Place Guide/Stone Assembly in Setting Gage with graduated slide set at "0" (see Figure 3-56 & 3-57).

10. Move graduated slide so that pin contacts guide. If pin does not contact guide, add a No. 19 shim and try again. Now add necessary shims as indicated on slide. Looseness less than thickness of one shim is acceptable.

Special instructions for using CK-4155 Setting Gage for large hone head in 102-203 mm (4-8 in.) range. Move graduated slide so that pin contacts assembly. If graduated slide reads "15" or less, no additional shims should be added. If slide reads over "15", remove assembly from Gage and add one shim.

NOTE: A properly shimmed assembly will slip into gage easily. Both Guide/Stone Assemblies must have same thickness of shims, and each must fit in Setting Gage when assembled with shims.

---

11. Rotate Drive Tube until numeral "1" appears on Hone Body. Insert one stone assembly with shims in left-hand set of holes beneath numeral.

12. Insert other shimmed Stone Assembly beneath numeral "2", using procedure above.

13. Insert shimmed Main Guide beneath numeral "3" on Hone Body.

NOTE: On CV-2400 and CV-4000 Hone Heads, Centering Guide and Main Guide are identical.

---

14. Place shimmed Centering Guide beneath numeral "4" on Hone Body.

Alignment Guide

NOTE: DO NOT use alignment guides when honing ported cylinders.

---

15. Place Alignment Guide in setting gage with graduated slide set at "0" (see Figure 3-58). Loosen Clamp with hex key wrench and slide to Shoulder as shown. Tighten Clamp and repeat procedure with second alignment guide.

16. Place one of alignment guides in left-hand set of holes above numeral "1" in hone body so that guide and stone are in line.

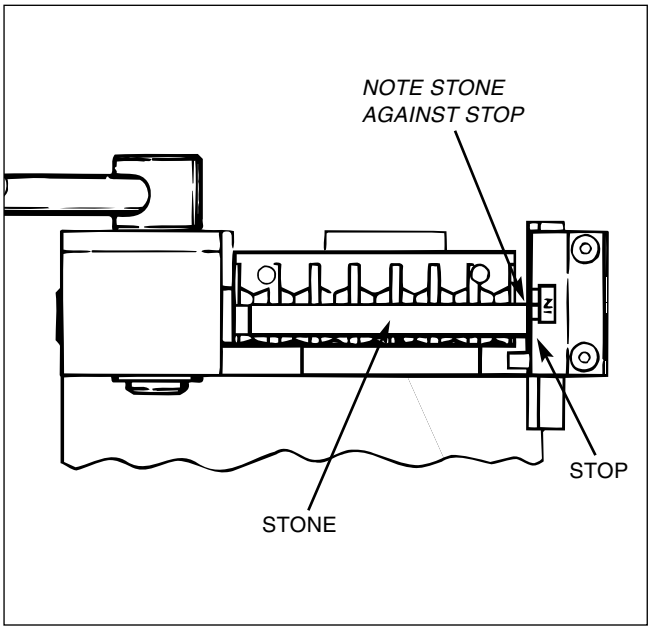


FIGURE 3-53, Install Stone

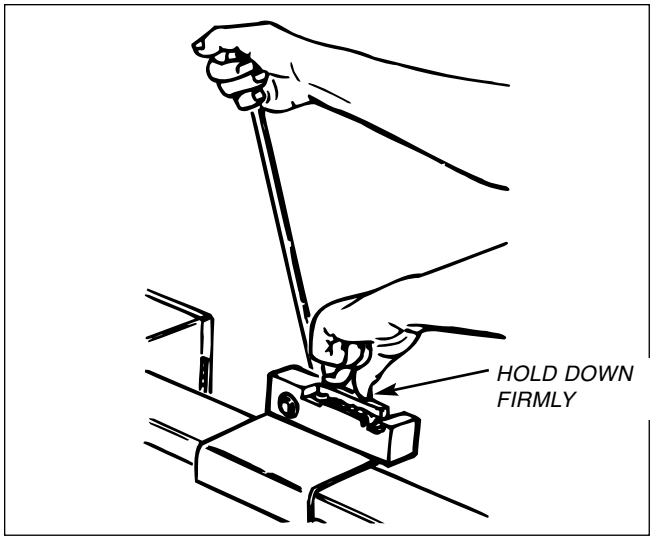


FIGURE 3-54 Seat Stone

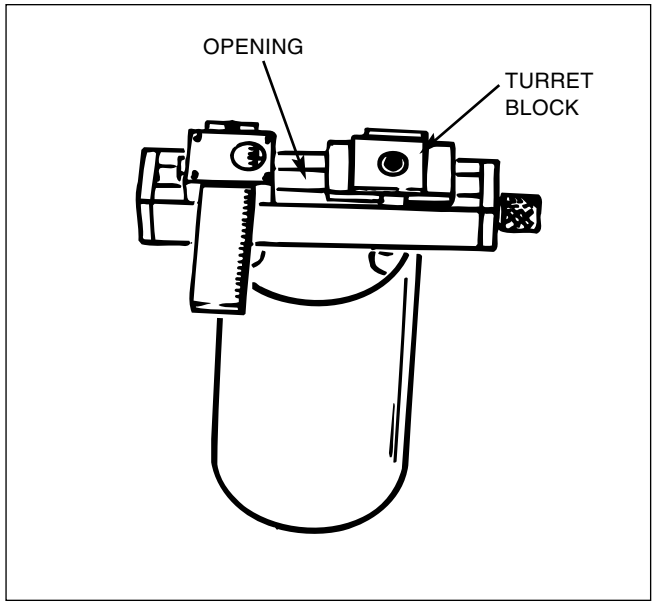


FIGURE 3-55, Setting Gage

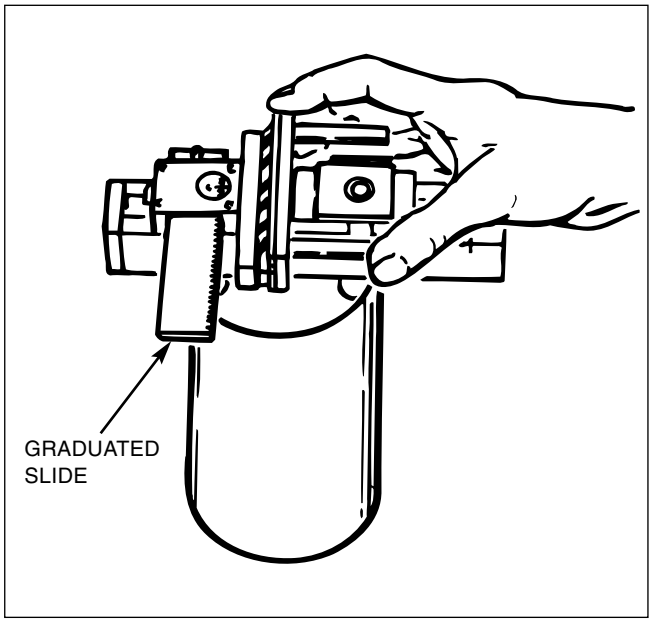


FIGURE 3-56, Stone Assembly

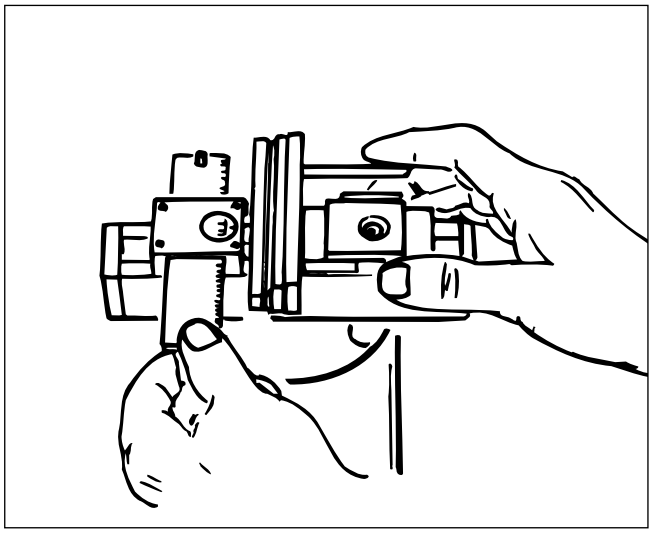


FIGURE 3-57, Main & Centering Guides

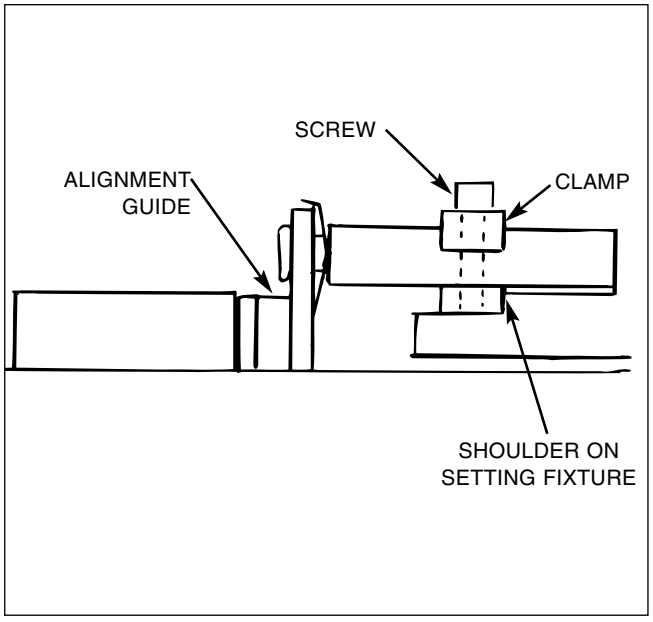


FIGURE 3-58, Alignment Guides

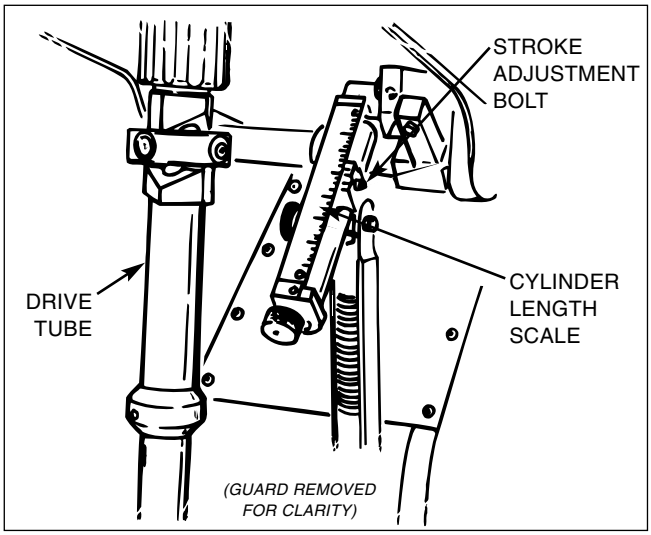


FIGURE 3-59, Stroke Length

17. Place other alignment guide in left-hand set of holes above numeral “2” in hone body so that guide and stone are also in line.

Machine Setup

WARNING

Never attempt to adjust stroke length while machine is on or operating. Always close front guards before operating machine.

CE Lock front guards before operating machine.

Set Stroke Length

1. Measure length of cylinder to be honed and length of honing stone.

The longer of measurements is desired stroke length. However, it may be necessary to use less than desired stroke length if:

- The desired stroke length is longer than 228 mm (9 in.) maximum, which is machine limit.
- The mandrel shank is not as long as Main Guide.
- Cutouts or thin walls near end of bore threaten stability of honing tool at end of a long stroke.
- Honing with CV Hone Head has resulted in bellmouth beyond straightness tolerance required in workpiece.

Maximum stroke length for blind holes is bore length minus 1/2 stone length.

4. Rotate feed handwheel to right and squeeze stones together until they are completely retracted.

Push centering guide against spring-loaded pin so that hone head will fit into cylinder.

5. Lower assembled hone head into cylinder to be honed by using lift lever.

6. Open both side guards.

7. If necessary, rotate Drive Tube until Stroke Adjustment is easily seen (see Figure 3-59).

8. Loosen Stroke Adjustment Bolt and turn Stroke Adjusting Knob so that index mark lines up with desired stroke length on graduated scale (see Figure 3-60). Tighten Stroke Adjustment Bolt.

NOTE: Make sure you are using correct Cylinder Length Scale for stone length being used. To replace Cylinder Length Scale, turn Scale Retainer Knob so scale can slide off to left. Replace with desired scale and turn Knob to secure scale.

Set Stroke Position/Overstroke

NOTE: Overstroke is amount that stone sticks out of bore.

9. Rotate Drive Tube until Hone Head is in its upper-most position and index marks are aligned.

10. Use Elevating Crank (see Figure 3-61) to position engine block so stones will extend above top of cylinder to be honed, according to Table 3-5. This should automatically position stones so they will not hit main bearing supports on bottom of stroke. However, in some cases main guide may hit main bearing web. Rotate hone by hand so that it will stroke through bottom of cylinder. If main guide does hit, remove that portion of shoe (bronze strip) that protrudes below guide holder.

11. If Elevating Crank will not raise or lower work-piece sufficiently to produce required top overstroke, loosen Set Screw in Drive Tube and adjust length of drive tube as required (see Figure 3-62); then tighten set screw.

The Set Screw should be screwed into hole in lower part of drive tub when index lines are in line.

12. Check setup by rotating Drive Tube by hand to cycle machine through one complete stroke.

Set Spindle Speed & Stroke Rate (SPM)

13. Measure cylinder diameter and cylinder length to nearest l mm (1/16 in.). Then select proper spindle speed and stroke rate from chart on inside belt cover (see Table 3-7).

14. Open left-hand side of belt cover.

15. Shift Drive Belt to position for desired spindle speed (see Figure 3-63).

16. Shift Stroke Belt to position for desired stroking rate.

17. Close belt cover.

CE Lock belt cover before attempting to operate. This cover is interlocked, and machine will not operate with cover in open position.

TABLE 3-5, Overstroke

Stone Length		Top Overstroke Setting	
inches	millimeters	inches	millimeters
2-3/4 in.	70 mm	3/8 in.	9,5 mm
3-1/2 in.	89 mm	5/8 in.	16 mm
4-1/2 in.	115 mm	13/16 in.	21 mm
6 in.	152 mm	1-1/16 in.	27 mm

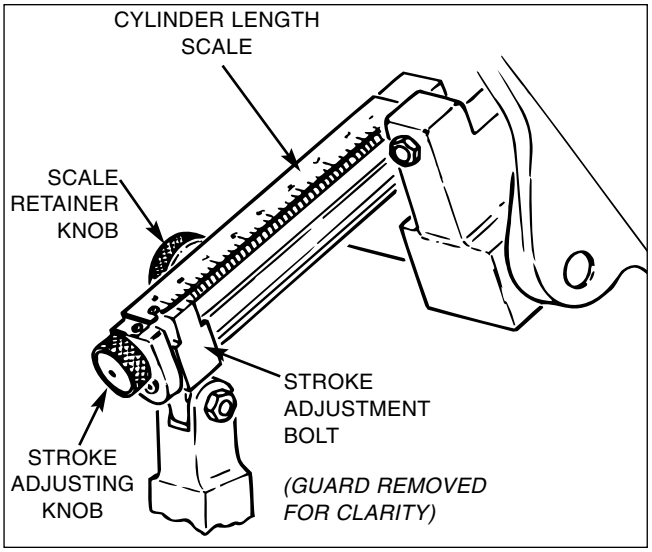


FIGURE 3-60, Stroke Adjustment

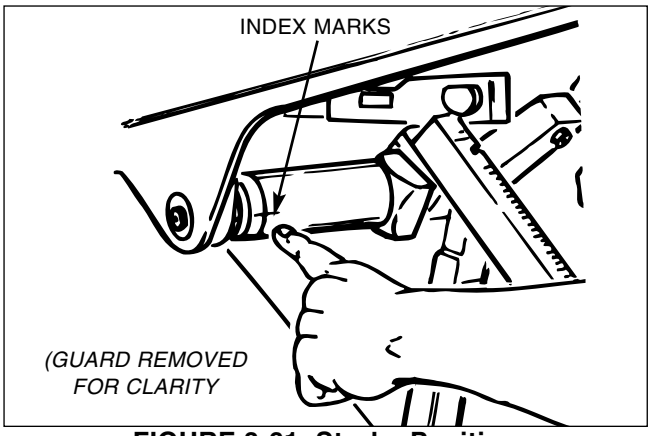


FIGURE 3-61, Stroke Position

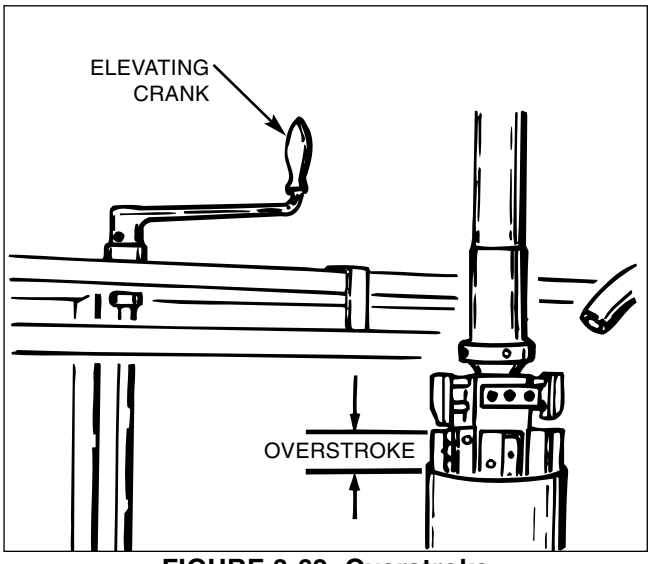
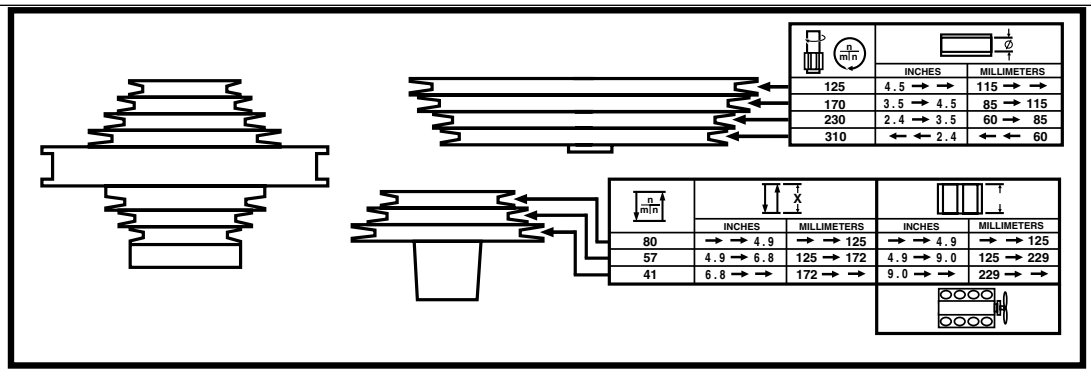


FIGURE 3-62, Overstroke

TABLE 3-6, Spindle Speed & Stroke Rate



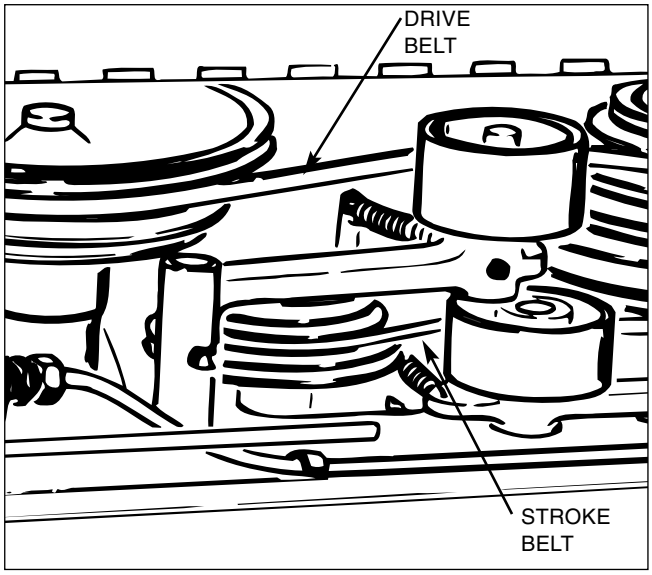


FIGURE 3-63, Spindle Belt

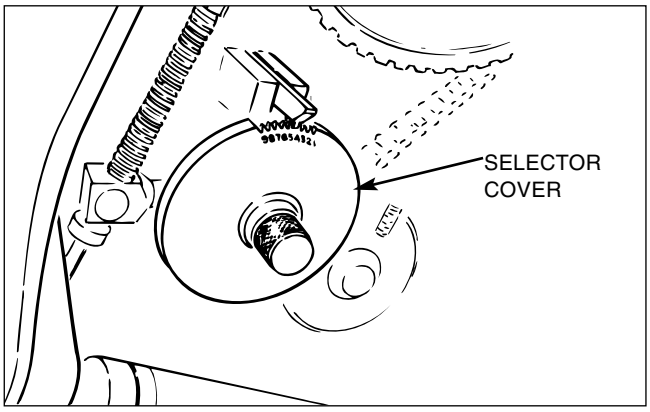


FIGURE 3-64, Feed Rate

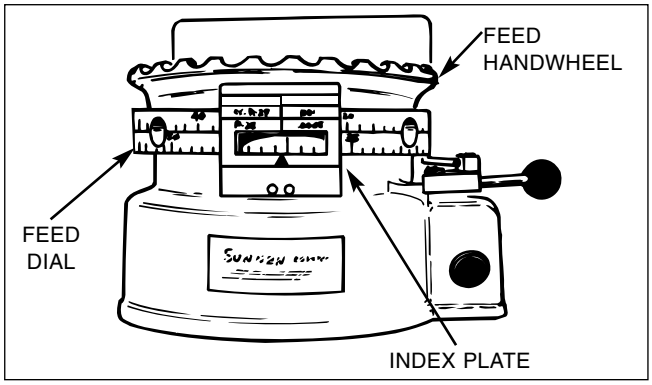


FIGURE 3-65, Feed Dial

Set Feed Rate

WARNING

Never attempt to adjust feed rate while machine is on or operating. Always close front guards before operating machine.

CE Lock front guards before operating machine.

18. Set Selector Cover. Rotate Selector Cover, not knob (see Figure 3-64).

For rough honing most passenger car blocks, set Selector Cover to “6”.

For finish honing most passenger car blocks, set Selector Cover to “4”.

For faster stock removal or rougher finish, use a higher number.

For longer stone life or smoother finish, use a lower number.

19. Set Feed Dial index Plate to indicate Honing Tool being used (see Figure 3-65).

NOTE: Index Plate has two sides; slide Plate from holder and invert if correct tooling is not shown on side being observed.

Measuring Taper

20. Set Sunnen Dial Bore Gage to standard cylinder diameter with a Sunnen Setting Fixture, suitable micrometer, or ring gage.

21. Gage bottom of cylinder (see Figure 3-66).

Gage “pocket” where largest diameter exists. If ridge has been removed, measure top of cylinder.

The difference between these two readings (bottom of cylinder and largest diameter) is taper to be removed.

Determine oversize to be honed by going to nearest standard oversize above amount of taper.

25. Reset Dial Bore Gage so “0” is desired finished size.

AUTOMOTIVE APPLICATION – OPERATION

Read rest of instructions to become familiar with correct honing procedure before starting machine.

Honing First Cylinder

1. Gage Bore. Determine amount of stock removal required. If you are rough honing, plan to leave 0,08 mm (.003 in.) for finish honing.

As an example, we will assume 0,18 mm (.007 in.) of stock needs to be removed.

2. Rotate Feed Handwheel to right to retract stones.

3. Squeeze stones together, push centering guide against spring-loaded pin, and lower hone head into cylinder to be honed (see Figure 3-67).

4. Rotate Feed Handwheel to left until snug (a slight resistance is felt); shake Drive Tube to seat stones (see Figure 3-68)

5. Slide Feed Dial to left until desired stock removal is shown in Index Plate (see Figure 3-69).

Feed Dial can slide to right on Feed Handwheel. Adjust Feed Dial for amount of stock to be removed. In our example you would move Feed Dial – Feed Handwheel does not move – until it shows 18 for metric machines (7 for domestic machines).

If there were no stone wear, machine would hone bore to size without any additional adjustment. However, there is stone wear, and you must compensate for it on each cylinder if you are going to "hit size".

As a place to start, assume that 2 units of stock are removed for every 1 unit of stone worn away. If you are finish honing, ratio will be closer to 1 to 1.

NOTE: Do not assume any stone wear if you are using Sunnen metal bonded diamond stones.

Example:

STOCK TO BE REMOVED ESTIMATED STONE WEAR

→ .007 x l/2 = .0035" ←

STONE WEAR TO STOCK REMOVAL RATIO

→ 0,18mm x 1/2 = 0,09mm ←

STOCK TO BE REMOVED ESTIMATED STONE WEAR

Adjust Feed Dial to right for amount of estimated stone wear, that is, 9 marks for metric machines (3-1/2 marks for domestic machines).

You should now read 27 on Feed Dial for metric machines (10-1/2 for domestic machines). This will be referred to as base number throughout these instructions. base number is always sum of stock to be removed, added to expected stone wear.

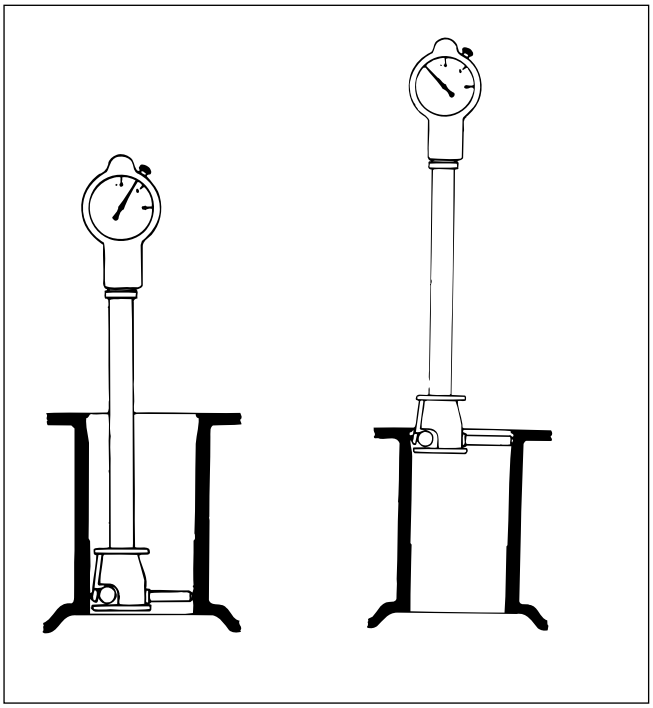


FIGURE 3-66, Gage Bore

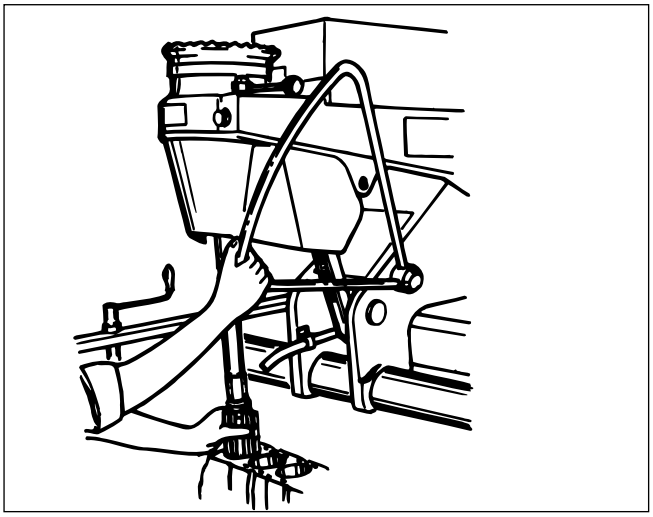


FIGURE 3-67, Insert Stones

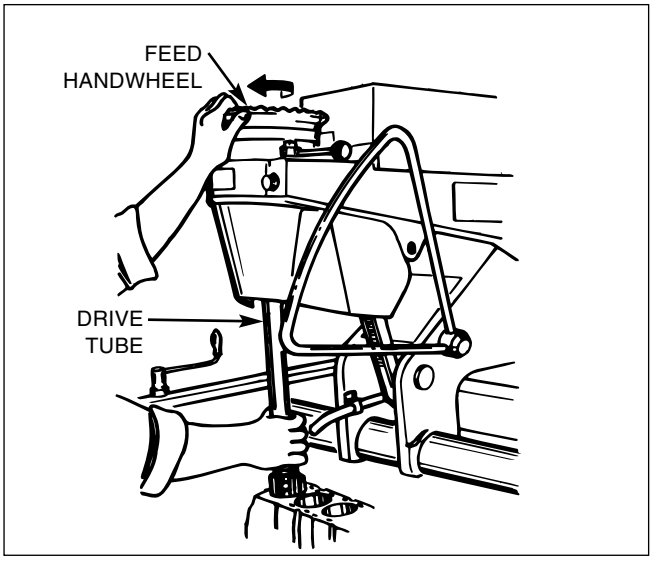


FIGURE 3-68, Feed Handwheel

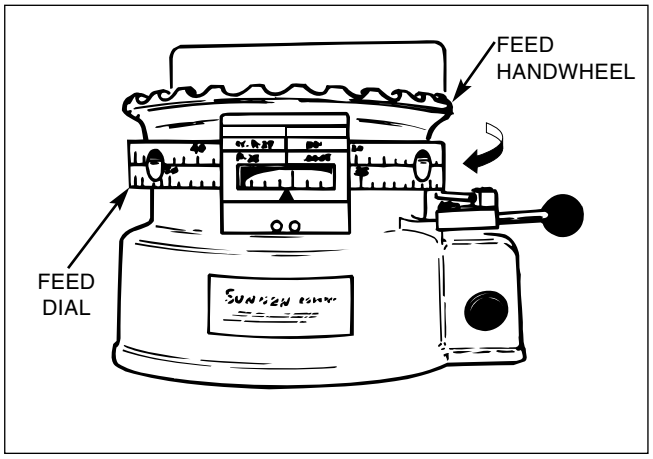


FIGURE 3-69 Feed Dial

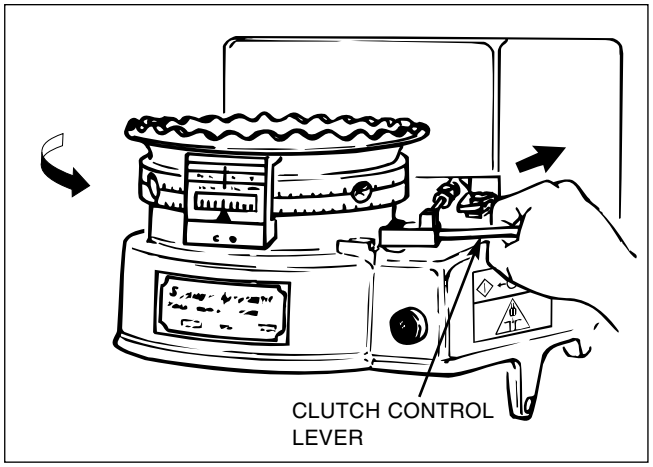


FIGURE 3-70 Clutch Control Lever

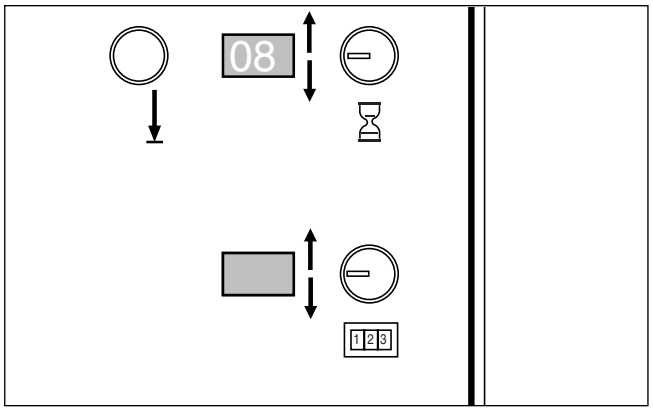


FIGURE 3-71, Dwell Cycle

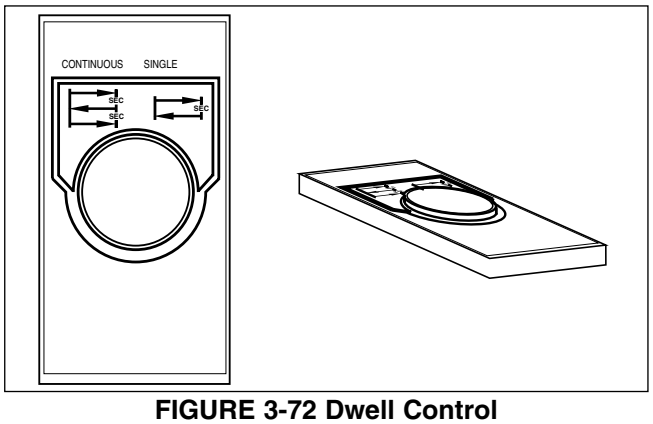


FIGURE 3-72 Dwell Control

Example:

.0070	(0,18 mm)	STOCK TO BE REMOVED
+.0035	(0,09 mm)	ESTIMATED STONE WEAR
.0105	(0,27 mm)	BASE NUMBER

The base number is number that must be represented on Feed Dial when machine is first at full load.

6. Rotate Feed Handwheel to right 5 to 10 marks as shown on Feed Dial. Push in on Clutch Control Lever to start motors, and then carefully pull lever fully forward.

Without hesitating after Step 5 above, rotate Feed Handwheel to left until load meter reads 80 (60 for finish honing) or more.

Start Machine:

7. Raise Disconnect Switch on Main Control Panel.

8. Set Mode Switch to Zero Shutoff or Timed. Timed: Machine will hone until number of seconds on Honing Time display reaches zero and head is at top of stroke. Zero Shutoff: Machine will hone until zero is reached on graduated feed dial and head is at top of stroke.

9. Rotate E-Stop Button to release.

10. Push white Power ON Button.

WARNING

Front splash guard must be raised to uppermost position before operating machine.

CE Front splash guard is interlocked, and machine will not operate if guard is not in uppermost position.

11. Raise front panel splash doors.

WARNING

Push Clutch Control Lever – DO NOT pull Clutch Control Lever forward.

12. Push Clutch Control Lever toward back of drive arm to start motors (see Figure 3-70).

13. Direct oil spout so that cylinder receives good flow of oil.

14. If taper was evident when gaging bore in step 1, set Dwell Cycle to required number of dwells. Approximately one dwell is required for each 0,025 mm (.001 in) of taper as determined in setup (see Figure 3-71).

NOTE: Make sure outer ring of Dwell Control is set at SINGLE (see Figure 3-72).

WARNING

DO NOT pull Clutch Control Lever forward to engage drive belt unless hone head is in bore.

15. Pull Clutch Control Lever forward slowly but steadily until it hits stop. This action engages main drive belts.

NOTE: Machine will shut off automatically when feed dial and feed handwheel move to “0” in zero shutoff mode or when honing time display reads “0” in timed mode.

---

16. Observe Honing Load Meter to check cylinder straightness after dwell cycle stops (see Figure 3-73).

The meter's display is calibrated at factory to display zero load when machine is stroking with no honing load, and 100% when machine is running at its two horsepower limit.

If display “swings” more than 10 points (i.e., difference between position of “bar” and “dot” is more than 10 points), and yellow light flashes when bar moves to right (in direction of increasing load), push dwell control button to remove taper. Repeat as necessary to decrease distance between bar and dot as much as possible. If a considerable number of dwells are required, increase number of dwells for next cylinder (see Figure 3-72 & 3-74).

If load display “swings” more than 10 points (i.e., difference between position of “bar” and “dot” is more than 10 points), and yellow light flashes when bar moves to left (in direction of decreasing load), wait several strokes to see if distance between bar and dot decreases. If load continues to vary by more than 10 points, rotate Elevating Crank one turn counterclockwise to lower engine block. When load display settles back to less than a 10 point swing, raise block back to its original position. If engine block required lowering, decrease number of dwells for next cylinder (see Figure 3-75 & 3-76).

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to “0”. In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

---

17. Push Clutch Control Lever back lightly to release Feed Handwheel. (When Clutch Control Lever is pushed back too far, it will start motors; if this happens, push Emergency Stop Button on Remote Control Panel.)

18. Rotate Feed Handwheel to right to release stone pressure. DO NOT slide feed dial in relation to handwheel.

19. Lift Control Lever to remove Hone Head from bore.

20. Gage bore. Bore should be undersize at this point. If was to at size, go to Hone Second Cylinder.

21. Place Honing Tool back into bore, squeezing guides to enter bore.

22. Rotate Handwheel to left until lightly snug. Note number on Feed Dial.

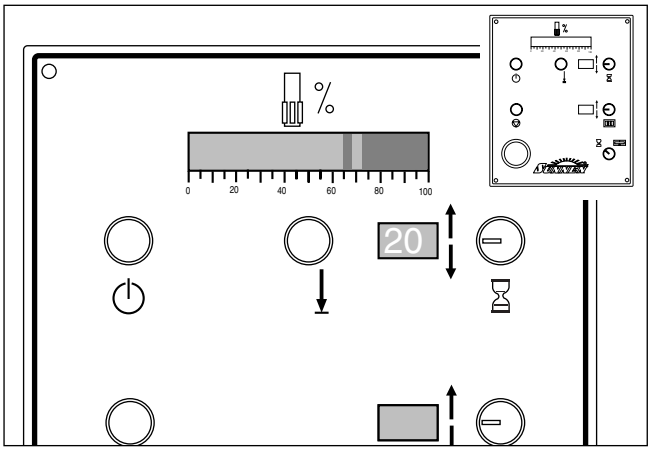


FIGURE 3-73, Honing Load Meter

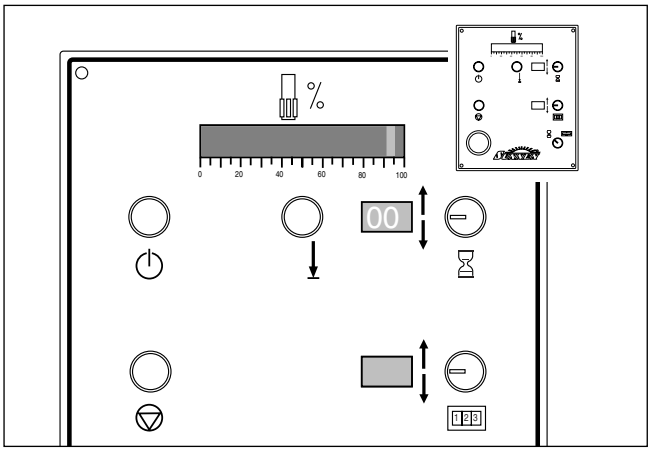


FIGURE 3-74, Dwell

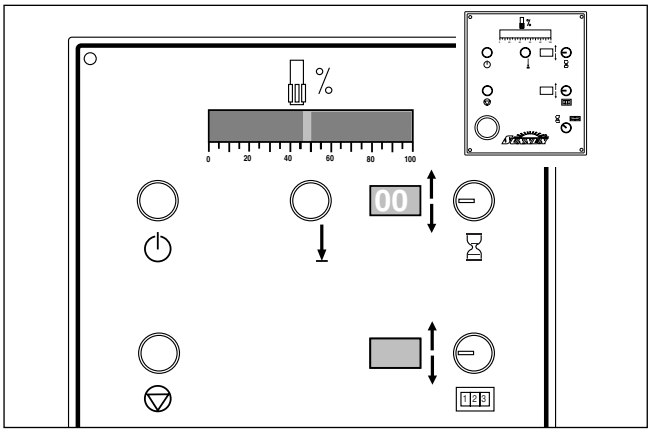


FIGURE 3-75, Dwell

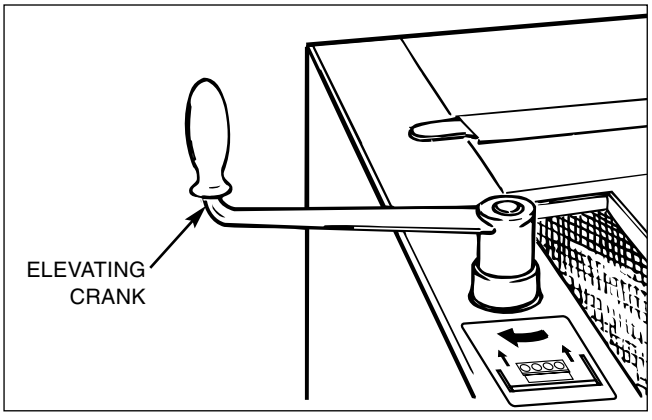


FIGURE 3-76 Dwell

23. Hold Handwheel firmly and slide Dial to right number of divisions that gage showed undersize in step 20.

24. Rotate Handwheel to right a few divisions to release stone pressure.

25. Start motors and engage drive belt Clutch Control.

26. Ease Handwheel to left until Dial indicates amount of stock removal needed.

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to "0". In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

---

27. Repeat Steps 15 thru 26 until FIRST CYLINDER is within size tolerance.

IMPORTANT

At this point, automatic shutoff has been set; Stone breakdown will be determined while honing second bore.

---

28. Adjusting Feed For Bore Being Honed

When last cylinder was under or oversize, add amount last cylinder was under or oversized to estimated stone wear for amount. Add to this, difference between original and new stone wear estimate for stock removal in present cylinder. This is amount you should slide Feed Dial. You will have a new stone wear estimate only if you had to recalculate your stone wear ratio.

Example:

AMOUNT OVER OR UNDER SIZED (FROM LAST CYLINDER)		1.0
STONE WEAR FOR THIS AMOUNT (1 x 3/4 = 3/4 ROUNDED DOWN)		0.5
NEW STONE WEAR ESTIMATE (7 x 3/4 = 5-1/4 ROUNDED DOWN TO 5)	5.0	
ORIGINAL STONE WEAR ESTIMATE (7 x 1/2 = 3-1/2)	3.5	
DIFFERENCE BETWEEN NEW AND ORIGINAL STONE WEAR ESTIMATES (5 – 3-1/2 = 1-1/2)		1.5
TOTAL		3.0

If last cylinder was undersize, hold Feed Handwheel still and slide Feed Dial to right number of marks you calculated. In our example it would be 3.

If you were oversize, hold Feed Handwheel still and slide Feed Dial to left number of marks you calculated. In our example it would be 3.

Hone Second Cylinder

1. Gage cylinder to determine amount of stock to be removed.

2. Place Honing Tool into cylinder.

3. Rotate Feed Handwheel to left until snug. DO NOT slide feed dial in relation to handwheel.

4. Advance Feed Dial number of divisions that you anticipate for stone wear. Remember to hold Handwheel firmly.

Adjust Feed Dial for amount of stock to be removed; plus, you must compensate for stone wear.

Stone wear is equal to total number of divisions that Feed Dial is advanced when honing second cylinder to size.

As a place to start, assume that 2 units of stock are removed for every 1 unit of stone worn away. If you are finish honing, ratio will be closer to 1 to 1.

NOTE: Do not assume any stone wear if you are using Sunnen metal bonded diamond stones.

---

5. Release stone pressure.

6. Push Clutch Control Lever toward rear of drive arm to start motors; then, pull Lever forward to engage drive belt.

IMPORTANT

Note starting position on graduated Feed Dial. Stone wear is equal to total number of divisions that Feed Dial is advanced when honing second cylinder to size.

---

7. Ease Handwheel to left until Dial indicates amount of stock removal needed.

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to "0". In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

---

8. When machine shuts off, remove Honing Tool and Gage Cylinder.

Repeat steps 2 thru 8 until SECOND CYLINDER is within tolerance.

NOTE: Once cylinder has a honed surface, there is no need to allow feed-up for easing in.

Hone Third & Subsequent Cylinders

1. Gage Cylinder to determine amount of stock to be removed.

2. Place Honing Tool into cylinder.

3. Rotate Handwheel to left until snug. DO NOT slide feed dial in relation to handwheel.

4. Advance Dial number of divisions that you anticipate for stone breakdown. If stock to be removed in third cylinder is same as for second one, stone breakdown should be same.

5. Release stone pressure.

6. Push Clutch Control Lever toward rear of drive arm to start motors; then, pull Lever forward to engage drive belt.

7. Ease Handwheel to left a few divisions.

NOTE: In Zero Shutoff Mode, Machine will shut off automatically when Feed Dial moves to “0”. In Timed Mode, Machine will shut off automatically when Honing Time display reaches zero.

8. When machine shuts off, remove Honing Tool and Gage Cylinder.

If stone wear was correctly anticipated, THIRD CYLINDER will be within size tolerance. Modify anticipated stone breakdown figure as required to keep subsequent cylinders within size tolerance.

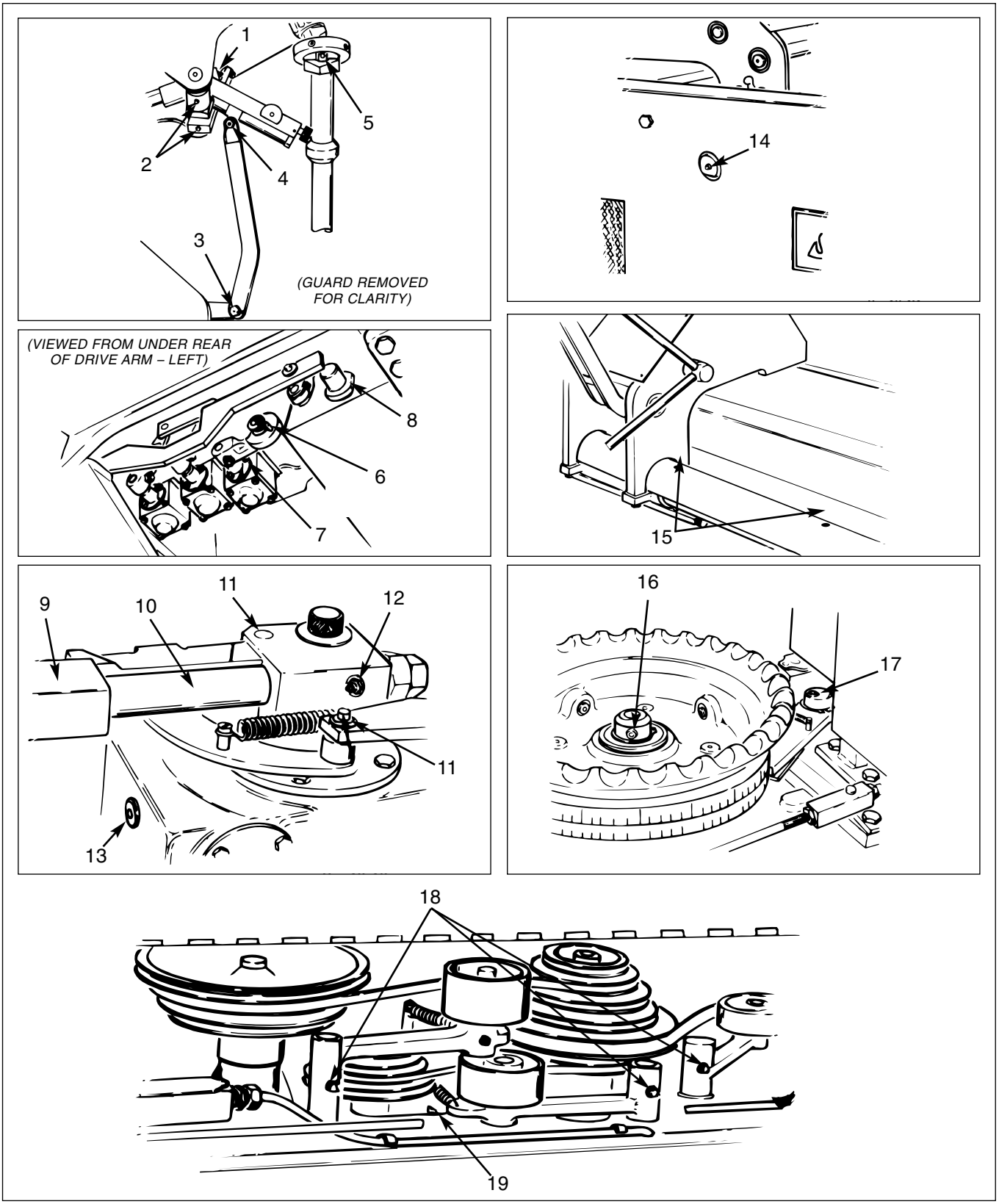


FIGURE 4-1, Lubrication

SECTION 4
ROUTINE MAINTENANCE

GENERAL
The following procedures and suggested maintenance periods are given as guides only and are not to be construed as absolute or invariable. Local conditions must always be considered. Each machine must be maintained individually according to its particular requirements.

CLEANING
Monthly, wipe exterior of Machine with a clean, dry cloth; then, clean exterior of Machine with warm water and a mild detergent or mild industrial solvent. Rinse thoroughly with clean, hot water and wipe dry.

LUBRICATION
Hand lubricate various machine components called out in Figure 4-1, according to suggested intervals called out in Table 4-1.

NOTE: The intervals between lubrication will vary with amount of use your machine receives. Lubricate all components at least once every six months.

COOLANT LINES CHECK
Monthly, inspect Coolant Lines and Fittings for leaks, severe dents or kinks. Tighten any leaking Fittings and replace damaged parts as required.

COOLANT LEVEL CHECK
Monthly, check level of Coolant in Coolant Reservoir and add Coolant as required by pouring coolant into Work Tray. Replace Coolant using ONLY Sunnen Industrial Honing Oil or Sunnen Water Based Coolant.

TABLE 4-1, Lubrication Points

#	DESCRIPTION	LUBRICANT	PROCEDURE	DAY	WEEK	MONTH	YEAR
1	Connecting Rod Needle Bearings	#2 Grease	2 Pumps		Once		
2	Stroke Rocker Arm (two points)	#2 Grease	2 Pumps		Once		
3	Lower Drive Arm to Carriage Connecting Strap Bearing	#2 Grease	2 Pumps		Once		
4	Upper Drive Arm to Carriage Connecting Strap Bearing	#2 Grease	Remove Plug from bolt & fitting. 2 Pumps. Replace Plug.			Once	
5	Upper Rod-feed Universal Joint	S.A.E. #20 Oil	Coat Universal	Once			
6	One-way Roller on Solenoid Energizer Switch	S.A.E. #20 Oil	1 Squirt	Once			
7	Electrical Limit Switch Shaft Bearings	S.A.E. #20 Oil	1 Squirt		Once		
8	Solenoid Plunger Bushing	S.A.E. #20 Oil	1 Squirt		Once		
9	Top of Connecting Rod where the Stroke Release Pawl rides	#2 Grease	Brush on	Once			
10	Connecting Rod Shaft	#2 Grease	Coat		Once		
11	Stroke Release Pawl Pivots (two points)	S.A.E. #20 Oil	1 Squirt		Once		
12	Stroke Release Block	#2 Grease	1 Pump	Once			
13	Gear Reducer	Gear Oil 140	Drain and refill				Once
14	Carriage Traverse Shaft (both ends)	#2 Grease	2 Pumps each			Once	
15	Carriage Traverse Shaft (two points)	S.A.E.#20 Oil	2 Squirts each	Once			
16	Handwheel Gears (not shown)	Lubriplate Low-Temp	Remove the Handwheel and repack Handwheel Gears.				Once
17	Feed Pawls	S.A.E. #20 Oil	Fill Oiler		Once		
18	Idler Arm Shafts (three points)	#2 Grease	1 Pump each	Once			
19	Gear Reducer Pulley Shaft	#2 Grease	1 Pump	Once			

FILTER REPLACEMENT

Replace Filter Element in Filter Canister as follows (see Figure 4-2):

1. Turn OFF all electrical power to machine.

2. Open Air Vents in Canister Covers (turn counterclockwise).

3. Place a bucket under Draincocks on bottom of Filter Canisters, and drain about 2 quarts (2 liters) of oil from the canister to prevent spillage when removing dirty element.

4. Close Draincocks and air vents.

5. Loosen Cover Clamps. Remove clamps and Canister Covers.

6. Slowly pull out dirty Filter Elements and place in a bucket to drain.

7. Clean Filter Canisters as required.

8. Remove new Filter Elements from protective bags and insert in Filter Canisters; rotate elements slightly so it will slide down center post more easily.

NOTE: For best results use Sunnen PF-105 Filter Elements.

---

9. Replace covers and clamps. Tighten Hex Bolt in Clamp Halves until halves meet, then tighten T-Handle.

NOTE: Ensure Seals are properly positioned before reinstalling Covers.

---

10. TURN ON electrical power.

11. Bleed Coolant System:

• Direct Coolant Nozzle downward and open Flow Control Knob.

• Turn ON power and start motors by pushing clutch lever all way back. Let pump run until all coolant nozzle delivers a steady stream of coolant.

• Pour an additional of approved coolant into Reservoir to top off system as Filter Canisters fill. The Coolant System holds a total of 208 liters (55 gallons) of coolant.

• Push POWER OFF Button.

12. Discard old Filter Element.

FILTER CANISTER CLEANING

Periodically clean Filter Canister as follows (see Figure 4-3):

1. Turn OFF all electrical power to machine.

2. Open Air Vents in Canister Covers (turn counterclockwise).

3. Place a suitable container under Draincocks on bottom of Filter Canisters, and drain oil from canisters.

4. Loosen Cover Clamps. Remove clamps and Canister Covers.

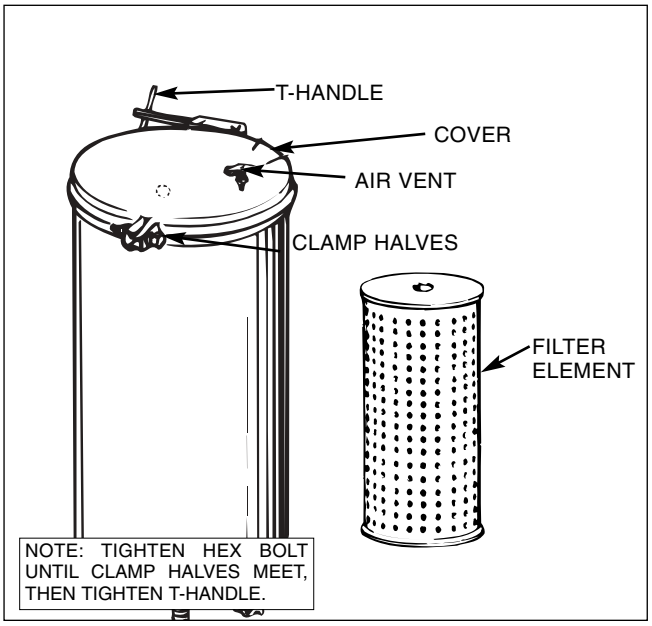


FIGURE 4-2, Filter Element Replacement

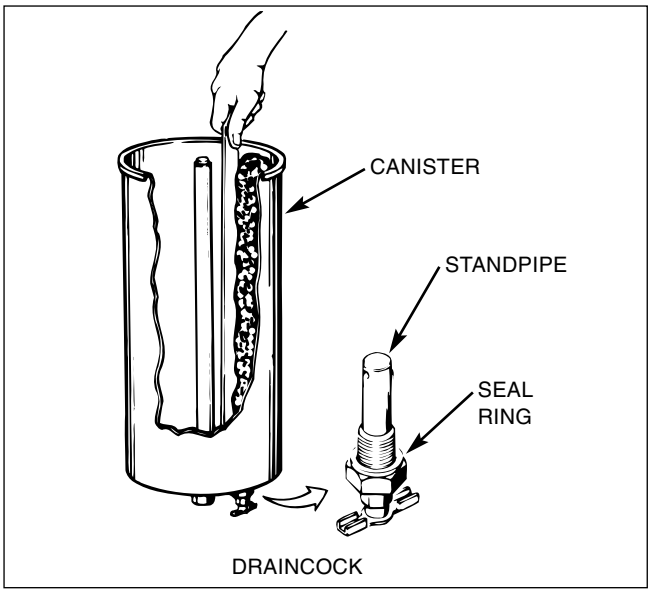


FIGURE 4-3, Filter Canister Cleaning

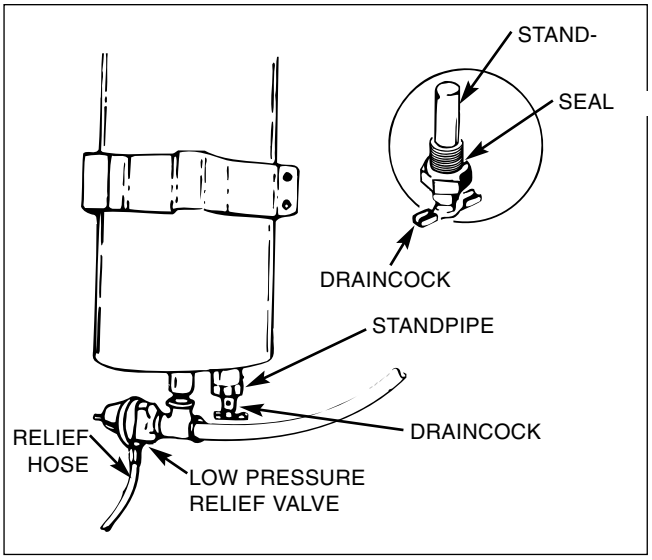


FIGURE 4-4, Filter Canister

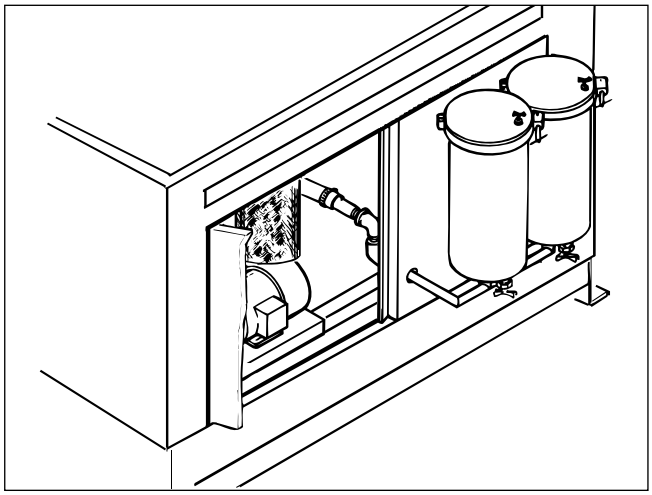


FIGURE 4-5, Coolant Reservoir

5. Slowly pull out dirty Filter Elements and place in a bucket to drain.

6. Remove Standpipes, using 1-l/2 in. (38 mm) open end wrench.

7. Scrape sludge from inside of canisters; use a long piece of wood or other soft material.

8. Flush out remaining sludge with solvent. Dispose of sludge.

9. Clean Standpipes and threaded fitting in Filter Canisters.

10. Inspect Standpipe Seal Rings and replace as necessary.

11. Coat Standpipe threaded fitting with Sealant and reinstall in Filter Canisters.

12. Close Draincocks and air vents.

13. Remove new Filter Elements from protective bag and insert in Filter Canisters; rotate element slightly so it will slide down center post more easily.

CAUTION

Ensure Seals are properly positioned before reinstalling Covers.

14. Replace covers and clamps. Tighten Hex Bolt in Clamp Halves until halvesmeet, then tighten T-Handle.

15. Push POWER ON Button to start Coolant Pump Motor.

16. Bleed Coolant System:

• Direct Coolant Nozzle downward, and open Knob on Flow Control Manifold.

• Turn ON power and start motors by pushing clutch lever all way back. Let pump run until all coolant nozzle delivers a steady stream of coolant.

• Pour an additional 19 liters (5 gallons) of approved coolant into Reservoir to top off system as Filter Canisters fill. The Coolant System holds a total of 208 liters (55 gallons) of coolant.

• Push POWER OFF Button.

17 . Discard old Filter Element.

COOLANT RESERVOIR CLEANING

Clean Coolant Reservoir as follows:

1. Turn OFF all electrical power to machine.

2. Lower Access Doors on front of machine.

3. Open Filter Door on rear of machine.

3. Open Air Vents in Canister Covers, by turning counterclockwise (see Figure 4-4).

4. Place a bucket under Draincocks on bottom of Filter Canisters, and drain coolant from the canisters.

5. Close Draincocks and air vents.

6. Clean and replace Filter Element.

7. Tip Settlement Tray and allow oil to drain into Reservoir (see Figure 4-5).

8. Remove Settlement Tray and clean.

9. Pump coolant from Reservoir.

10. Remove Intake Strainer from Intake Strainer Mounting Bracket.

11. Dip or pour out any coolant remaining in Reservoir.

12. Dip and scrape sludge from Reservoir.

13. Flush any remaining sludge from Reservoir and Settlement Tray with a mild industrial solvent, if necessary.

14. Wipe reservoir and tray dry.

15. Clean Intake Strainer as required.

16. Insert Intake Strainer into Intake Strainer Mounting Bracket.

17. Pump or pour Sunnen Industrial Honing Oil or Sunnen Water-Based Coolant into Coolant Reservoir.

18. Reinstall Settlement Tray.

19. Replace Filter Element and Filter Cover.

20. Bleed Coolant System (refer to Figure 4-6 on top of next page):

• Direct Coolant Nozzle downward and open Flow Control Knob.

• Turn ON power and start motors by pushing clutch lever all way back. Let pump run until all coolant nozzle delivers a steady stream of coolant.

• Pour an additional of approved coolant into Reservoir to top off system as Filter Canisters fill. The Coolant System holds a total of 208 liters (55 gallons) of coolant.

• Push POWER OFF Button.

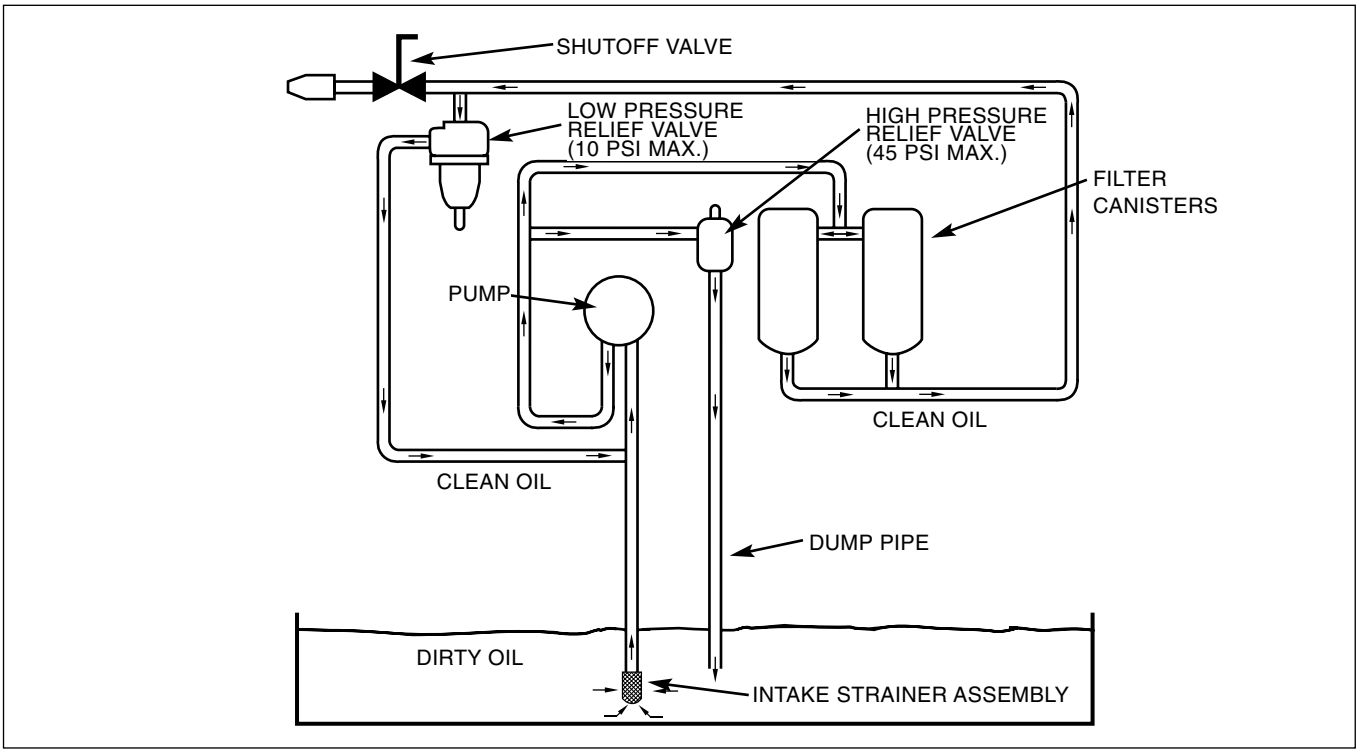


FIGURE 4-6, Oil Flow Diagram

TIMING BELT ADJUSTMENT

Periodically check Timing Belt as follows (see Figure 4-7):

1. Push against Timing Belt with finger pressure. The Timing Belt should deflect no more than 6 mm (1/4 in.). To adjust, proceed as follows:

- Get a 9/16 in. and a 3/4 in. socket wrench.
- Loosen Timing Belt Idler Arm.
- Loosen Back Stop for Idler Arm.
- Rotate Back Stop into Idler Arm to increase tension, or rotate Stop away from Arm to decrease tension.
- Tighten Back Stop and Idler Arm.

2. Check belt for missing teeth. To replace, proceed as follows:

- Get a 1/2 in. end wrench and 9/16 in. and 3/4 in. socket wrenches.
- Remove Feed Push Rod from Feed Crank by removing Cap Screw. DO NOT move Lock Nut; it will disturb length setting of Feed Push Rod.
- Loosen Idler Arm and Back Stop.
- Remove Timing Belt.
- Install new Belt, and adjust belt tension. Rotate Back Stop into Idler Arm to increase tension, or rotate Stop away from Arm to decrease tension.
- Tighten Back Stop and Idler Arm.
- Reconnect Feed Push Rod to Feed Crank.

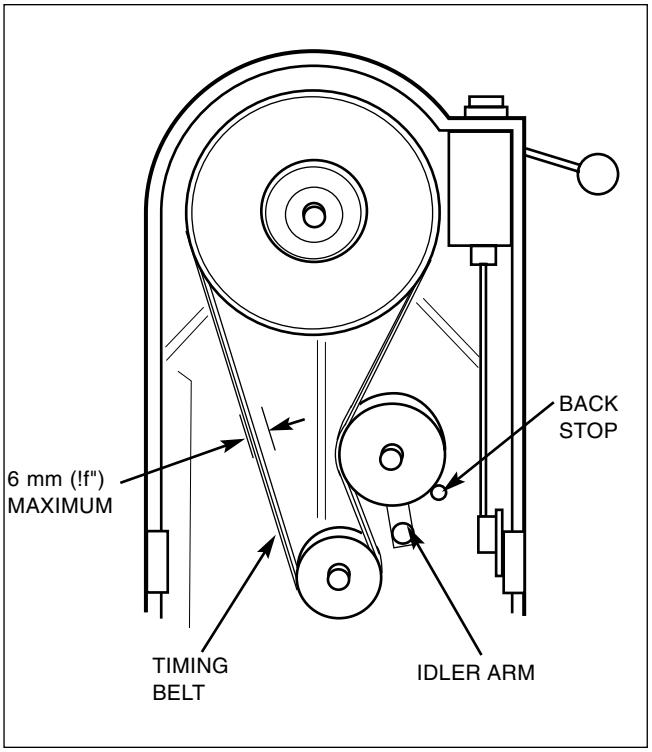


FIGURE 4-7, Timing Belt

SECTION 5
TROUBLESHOOTING

GENERAL

This section contains Troubleshooting information in table form which should be used when problems occur with machine. The table lists problems encountered, possible causes, and solutions for problems along with reference to section of manual where detailed instructions may be found to correct problems.

OPERATIONAL TROUBLESHOOTING

For suggestions on correcting problems with bore conditions or with honing operation; consult Table 5-1.

TABLE 5-1, Operational Troubleshooting Index

PROBLEM	PROBABLE CAUSE	SOLUTIONS	SEC.
Tool generates high load	1. High feed rate	A. Lower feed rate	3
	2. Worn tool	A. Replace tool	2
	3. Tool Loading (Metal particles on tool surface)	A. Dress tool	3
		B. Increase tool's rpm	
		C. Check coolant*	1
Slow stock removal	1. Inadequate tool feed rate	A. Increase feed rate	3
	2. Improper tool	A. Replace tool (courser grit tool)	2
	3. Improper or diluted coolant*	A. Check coolant*	1
Poor tool life	1. Excessive tool feed rate	A. Decrease feed rate	3
	2. Excessive stock removal	A. Decrease stock removal	3
	3. Improper tool	A. Replace tool	
	4. Improper or diluted coolant*	A. Check coolant*	1
	5. Inadequate tool rpm	A. Increase tool's rpm	3
Bellmouth	1. Improper stroke length	A. Shorten stroke length	3
	2. Excessive float in tool(s)	A. Decrease tool float	2
	3. Worn guide bushings	A. Replace bushings	4
Barrel	1. Improper stroke length	A. Increase stroke length	3
Taper in Open End	1. Part geometry or tool geometry	A. Readjust stroke position	3

***NOTE:** Many honing problems, such as poor tool life and rough finish, are caused by the following: the wrong coolant, insufficient coolant, dirty coolant, or contaminated coolant. Use ONLY clean, full-strength Sunnen Industrial Honing Oils or Water-Based Coolants. DO NOT dilute or "cut" the oil or coolant in your Machine with other oils or coolants. Keep solvents and cleaning fluids away from your Machine.

TABLE 5-1, Operational Troubleshooting Index (Cont'd)

PROBLEM	PROBABLE CAUSE	SOLUTIONS	SEC.
Out-Of-Round	1. Workpiece flexing (thinwall)	A. Decrease feed	3
		B. Change method of fixturing	2
		C. Decrease spindle speed	
		D. Reduce stock removal	
	2. Excessive float in tool(s)	A. Decrease tool float	
	3. Fixture not properly Aligned	A. Adjust Fixture	2
Rough Finish	1. Material loading tool	A. Inspect & clean	
	2. High feed rate	A. Decrease feed	3
	3. Improper tool	A. Use finer grit	
	4. Improper or diluted coolant*	A. Check coolant*	1

***NOTE:** Many honing problems, such as poor tool life and rough finish, are caused by the following: the wrong coolant, insufficient coolant, dirty coolant, or contaminated coolant. Use ONLY clean, full-strength Sunnen Industrial Honing Oils or Water-Based Coolants. DO NOT dilute or “cut” the oil or coolant in your Machine with other oils or coolants. Keep solvents and cleaning fluids away from your Machine.

GENERAL TROUBLESHOOTING INDEX

For suggestions on correcting problems due to improper machine setup or adjustment, consult Table 5-2.

NOTE: Troubleshooting electrical components is a job for a qualified electrician; therefore, instructions are no more detailed than needed by such a qualified person. If you don't know how to perform the checks required, do not attempt to troubleshoot an electrical system.

TABLE 5-2, General Troubleshooting Index

PROBLEM	PROBABLE CAUSE	SOLUTIONS	SEC.
Motors do not start when Clutch Control Lever is pushed back. Light ON, but goes out when Lever is released.	1. Motor Overloads tripped.	A. Press Reset Button.	
	2. Auxiliary Contact defective.	A. Replace Contact (1M2).	
	3. Motor Starter defective.	A. Replace Starter.	
	4. Loose connections or broken wire at Terminal 2, 3, 4, 13, 14, X1 or X2.	A. Correct by securing wires properly.	
	5. L3 fuse blown.	A. Replace Fuse (1FU).	
Motors do not start when Clutch Control Lever is pushed back. Light OUT.	1. Disconnect Switch is in "OFF" position.	A. Turn "ON" Switch.	
	2. Feed Handwheel is in "OFF" position (between 2.08 mm and 0).	A. Increase Feed Handwheel setting.	
	3. Lift Lever not lowered.	A. Lower Hone Tool into normal working position inside the workpiece.	
	4. Lift Lever Safety Switch is not set properly or defective.	A. Adjust Lift Lever Safety Switch (8LS).	
	5. Clutch Control Lever not contacting Start Switch.	A. Adjust Clutch Lever.	
	6. 1FU Fuse blown.	A. Replace Fuse. There are three 1FU Fuses, only one of which is likely to be blown.	
	7. 2FU Fuse blown.	A. Replace Fuse.	
	8. Transformer supplying control voltage is disconnected, improperly connected, or burned out.	A. Reconnect properly or replace. Refer to Wiring Diagram supplied with machine.	
	9. Loose connections or broken wire at Terminal 2, 3, 4, 13, 14, X1 or X2.	A. Correct by securing wires properly.	
Machine fails to dwell properly. With Dwell Timer TM, but will operate manually.	1. Leads or connections associated with Dwell Timer TM or Terminals 11, 9, or 4 defective.	A. Reconnect properly or replace. Refer to Wiring Diagram supplied with machine.	
	2. Defective contacts on clock motor.	A. Replace Dwell Timer TM.	
Machine fails to dwell properly when Dwell Selector outer ring is set either at "SINGLE" or "CONT."	1. Dwell Selector Pushbutton is defective.	A. Replace Button.	
	2. Auxiliary Contact is defective.	A. Replace Contact (1M3) .	
	3. Loose connections or broken wire at Terminal 2, 3, 4, 13, 14, X1 or X2.	A. Correct by securing wires properly.	

TABLE 5-2, General Troubleshooting Index (Cont'd)

PROBLEM	PROBABLE CAUSE	SOLUTIONS	SEC.
Machine fails to dwell properly. When Dwell Selector outer ring is set to "CONT," but will Dwell when to "SINGLE."	1. Dwell Selector Pushbutton is defective.	A. Replace Button.	
Hone Tool stays in bottom of hole during dwell and won't come out.	1. Rocker Stop Cushion improperly adjusted. 2. Stroking Rocker Clearance improperly adjusted.	A. Adjust Rocker Stop Cushion. A. Adjust Stroking Rocker Clearance.	
Machine continues to dwell on every other stroke. (Normal operation for continuous dwell mode.)	1. Dwell Selector Pushbutton outer ring set to "CONT." 2. Loose connections at 4, 9. 3. Dwell Selector Pushbutton is defective. 4. Relay Contact is defective; will not open. 5. Dwell Timer Cams improperly set.	A. Turn Ring to "SINGLE." A. Correct by securing wires properly. A. Replace Button. A. Replace Contact (2CR). A. Adjust Cams.	
Machine "slams" or "bounces" during or after dwelling.	1. Rocker Stop Cushion improperly adjusted. 2. Stroking Rocker Clearance improperly adjusted. 3. Honing load too light.	A. Adjust Rocker Stop Cushion. A. Adjust Stroking Rocker Clearance. A. Add weights.	
Hone head chatters.	1. Check Main Guide Shims. 2. Timing belt loose or teeth missing. 3. Gage Calibration improperly set. 4. Loose Universal Ring.	A. Add or remove Shims as required. A. Adjust Belt Tension or replace Belt. A. Set Gage Calibration. A. Tighten Ring; four Screws should be tight.	
Stones do not feed out. Shim fits.	1. Wedge was at end of its travel.	A. Add Shims.	
Stones do not feed out. Shim Does Not Fit, but Stones Do Not Expand.	1. Feed Handwheel set screw loose. 2. Broken Planetary Gears. 3. Broken Feed Rod. 4. Broken Wedge.	A. Tighten set screw. A. Replace Gear. A. Replace Feed Rod. A. Replace Wedge.	

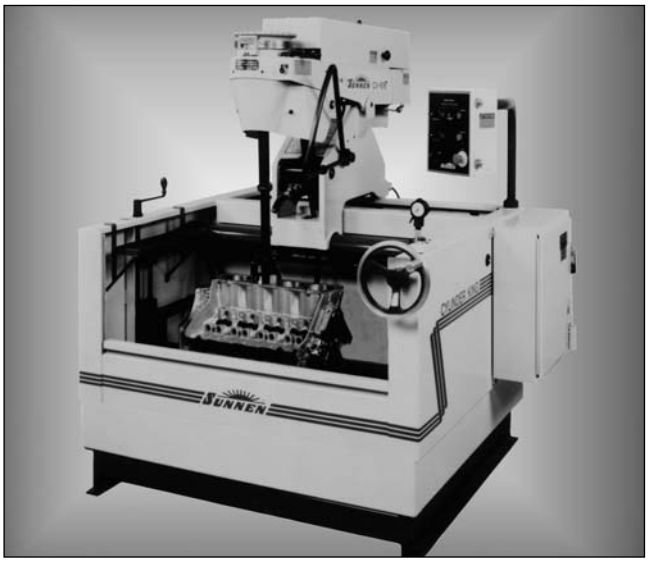
TABLE 5-2, General Troubleshooting Index (Cont'd)

PROBLEM	PROBABLE CAUSE	SOLUTIONS	SEC.
Stones do not feed out. Shim Does Not Fit; Stones Expand, but Pawls are not moving.	1. Feed setting less than 1. 2. Variable Feed Ratchet set incorrectly. 3. Feed Overload Spring set incorrectly. 4. Feed Push Rod improperly connected.	A. Increase Feed setting. A. Adjust Ratchet. A. Adjust Spring. A. Adjust Feed Push Rod.	
Stones do not feed out. Shim Does Not Fit; Stones Expand, and Pawls are moving.	1. Clutch Mechanism improperly set. 2. Pawl Spring missing or broken.	A. Adjust Clutch. A. Replace Spring.	
Machine does not shut off when Feed Handwheel reaches zero.	1. Feed Handwheel Limit Switch Arm improperly set. 2. Defective Limit Switch. 3. Auto Cycle Stop Switch improperly set.	A. Adjust Arm. A. Replace Switch. A. Adjust Switch.	
Machine does not shut off when Stop Pushbutton is pushed.	1. Defective Stop Pushbutton Switch. 2. Defective Motor Starter.	A. Replace Switch. A. Replace Starter.	
Machine does not shut off when Feed Handwheel reaches “0” & when Stop Button is pushed.	1. Clutch Mechanism improperly set. 2. Defective Motor Start Switch.	A. Adjust/set Motor Start Switch (2LS). A. Replace Switch (2LS).	
Machine “knocks” at end of each stroke.	1. Very high load. 2. Excessive carriage shoe clearance. 3. Stroke Release Pawl improperly set. 4. Loose or damaged Stroking Linkage.	A. Use softer stones. A. Adjust clearance. A. Adjust Pawl. A. Adjust Linkage. B. Replace Linkage.	
“Motor ON” Indicator Light does not burn when motors are running.	1. Defective or burned out Bulb. 2. Loose connection at 3 or 4.	A. Replace Bulb. A. Tighten connections.	
Stroke Bottom Light (Amber) Does not light at bottom of stroke. Light is not burned out.	1. Improper setting Stroke Bottom Light Switch.	A. Adjust Switch setting.	

TABLE 5-2, General Troubleshooting Index (Cont'd)

PROBLEM	PROBABLE CAUSE	SOLUTIONS	SEC.
Stroke Bottom Light (Amber) Does not light at all.	1. Defective Bulb. 2. Improper setting Stroke Bottom Light Switch. 3. Loose connection at 15, 12, or 4. 4. Defective Stroke Bottom Light Switch.	A. Replace Bulb. A. Adjust Switch setting. A. Tighten connections. A. Replace Switch.	
Stroke Bottom Light (Amber) Light burns all the time.	1. Improper setting Stroke Bottom Light Switch. 2. Defective Stroke Bottom Light Switch.	A. Adjust Switch setting. A. Replace Switch.	

COOLANT FLOW DIAGRAM



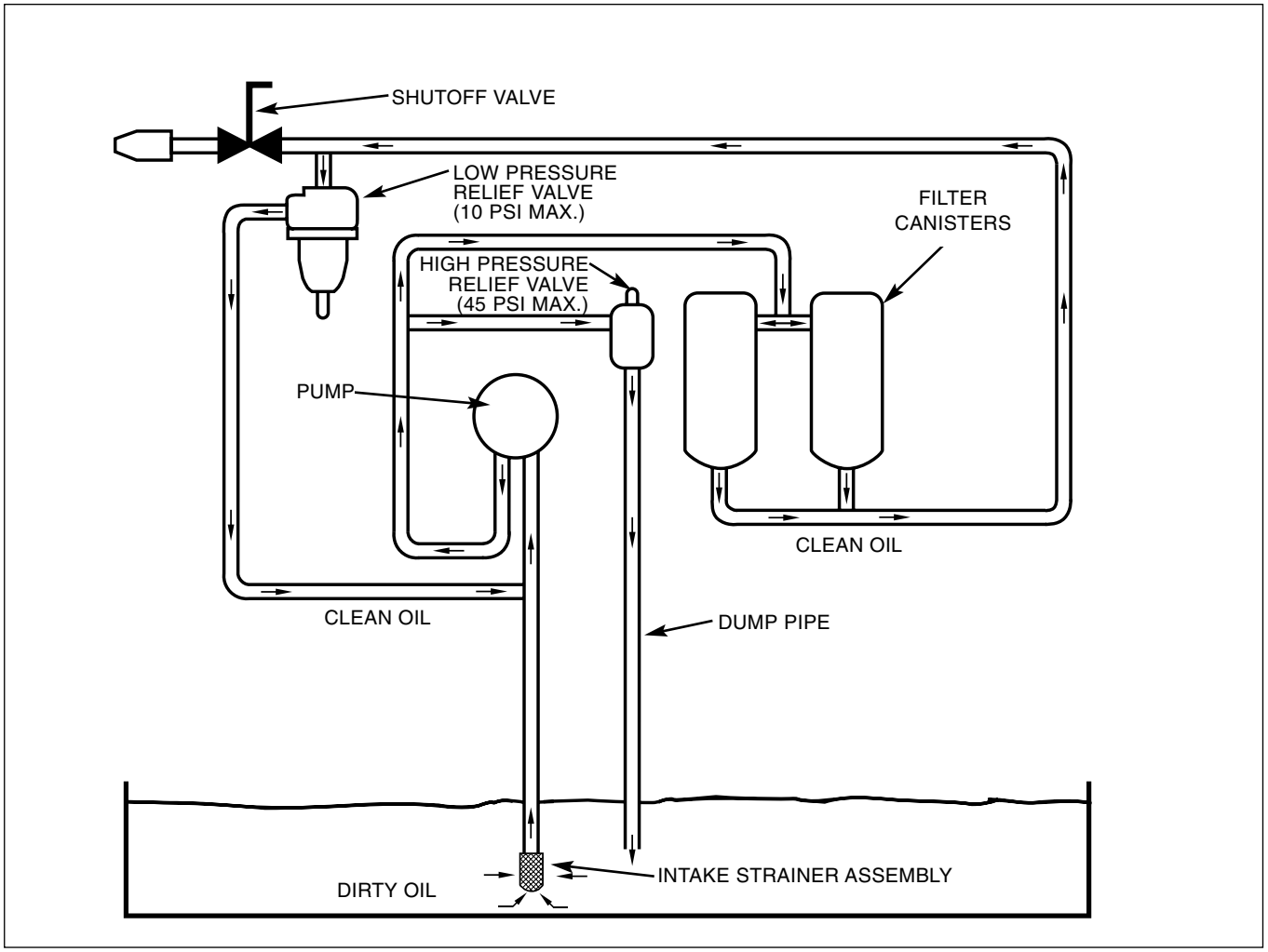


FIGURE A-1, Coolant Flow Diagram

NOTES

Like any machinery, this equipment may be dangerous if used improperly. Be sure to read and follow instructions for operation of equipment.

FRACTION / DECIMAL / MILLIMETER EQUIVALENTS CHART

INCH FRACTION	INCH DECIMAL	MILLIMETER	INCH FRACTION	INCH DECIMAL	MILLIMETER	INCH FRACTION	INCH DECIMAL	MILLIMETER
. . . .	.003937	0,1000	9/32	.281250	7,1438	21/32	.656250	16,6688
. . . .	.007874	0,2000	19/64	.296875	7,5406	. . . .	.669291	17,0000
. . . .	.011811	0,3000	5/16	.312500	7,9375	43/64	.671875	17,0656
1/64	.015625	0,3969	. . . .	.314961	8,0000	11/16	.687500	17,4625
. . . .	.015748	0,4000	21/64	.328125	8,3344	45/64	.703125	17,8594
. . . .	.019685	0,5000	11/32	.343750	8,7313	. . . .	.708661	18,0000
. . . .	.023622	0,6000	. . . .	.354331	9,0000	23/32	.718750	18,2563
. . . .	.027559	0,7000	23/64	.359375	9,1281	47/64	.734375	18,6531
1/32	.031250	0,7938	3/8	.375000	9,5250	. . . .	.748031	19,0000
. . . .	.031496	0,8000	25/64	.390625	9,9219	3/4	.750000	19,0500
. . . .	.035433	0,9000	. . . .	.393701	10,0000	49/64	.765625	19,4469
. . . .	.039370	1,0000	13/32	.406250	10,3188	25/32	.781250	19,8438
3/64	.046875	1,1906	27/64	.421875	10,7156	. . . .	.787402	20,0000
1/16	.062500	1,5875	. . . .	.433071	11,0000	51/64	.796875	20,2406
5/64	.078125	1,9844	7/16	.437500	11,1125	13/16	.812500	20,6375
. . . .	.078740	2,0000	29/64	.453125	11,5094	. . . .	.826772	21,0000
3/32	.093750	2,3813	15/32	.468750	11,9063	53/64	.828125	21,0344
7/64	.109375	2,7781	. . . .	.472441	12,0000	27/32	.843750	21,4313
. . . .	.118110	3,0000	31/64	.484375	12,3031	55/64	.859375	21,8281
1/8	.125000	3,1750	1/2	.500000	12,7000	. . . .	.866142	22,0000
9/64	.140625	3,5719	. . . .	.511811	13,0000	7/8	.875000	22,2250
5/32	.156250	3,9688	33/64	.515625	13,0969	57/64	.890625	22,6219
. . . .	.157480	4,0000	17/32	.531250	13,4938	. . . .	.905512	23,0000
11/64	.171875	4,3656	35/64	.546875	13,8906	29/32	.906250	23,0188
3/16	.187500	4,7625	. . . .	.551181	14,0000	59/64	.921875	23,4156
. . . .	.196850	5,0000	9/16	.562500	14,2875	15/16	.937500	23,8125
13/64	.203125	5,1594	37/64	.578125	14,6844	. . . .	.944882	24,0000
7/32	.218750	5,5563	. . . .	.590551	15,0000	61/64	.953125	24,2094
15/64	.234375	5,9531	19/32	.593750	15,0813	31/32	.968750	24,6063
. . . .	.236220	6,0000	39/64	.609375	15,4781	. . . .	.984252	25,0000
1/4	.250000	6,3500	5/8	.625000	15,8750	63/64	.984375	25,0031
17/64	.265625	6,7469	. . . .	.629921	16,0000	1	1.000000	25,4000
. . . .	.275591	7,0000	41/64	.640625	16,2719	1-1/16	1.062500	26,9880

FORMULAS:

MULTIPLY		BY		TO GET
INCHES (in)	x	25.4	=	MILLIMETERS (mm)
FEET (ft)	x	0.3048	=	METERS (m)

MULTIPLY		BY		TO GET
MILLIMETERS (mm)	x	0.03937	=	INCHES (in)
METERS (m)	x	3.281	=	FEET (ft)

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